THE STUDY OF ANTHROPOMETRIC MEASUREMENTS AND IMMUNIZATION STATUS OF PRE-SCHOOL CHILDREN

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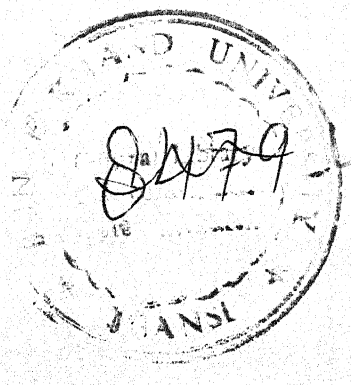

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CERTIFICATE

This is to certify that the work entitled 'THE STUDY OF ANTHROPOMETRIC MEASUREMENTS AND IMMUNIZATION STATUS OF PRE-SCHOOL CHILDREN' has been carried out by Anil Kumar, under my direct supervision and guidance in the Department of Paediatrics, M.L.B. Medical College, Jhansi.

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A WORD OF HONOUR

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Dated: Feb. 21, 1981.

(ANIL KUMAR)

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At last but not the least, to the little babies, children and their parents without whose co-operation this study could not be made a success, I shall remain thankful for ever.

Dated: Feb. 21, 1981.

(ANIL KUMAR)

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INTRODUCTION

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In India, out of a total population of 600 million, 42.5% are below 14 years of age, which puts total child population at 232 million. Children below 5 years constitute 17% of total population that is approximately 100 million and to this 15 million are added every year.

Pre-school children not only form the bulk of child population but also constitute the most vulnerable segment of total population. It is at this stage of rapid growth, exploration and interaction with the environment that a child is prone to encounter accidents, develop malnutrition and suffer from behaviour problems.

As was rightly said by our first Prime Minister Sri Jawaharlal Nehru, that "Nation marches on the tiny feet of little individuals, and hence no nation can afford to ignore its children". Any expenditure incurred on their welfare should be considered an investment rather than wasteful expenditure.

Constructive planning for the health services of children must be based on some pre-existing knowledge regarding the state of health in children. The more extensive this knowledge is, the better will be the planning. For the assessment of health status in a

community, various methods are available viz., the clinical assessment, biochemical assessment and the nutritional anthropometry. Though, the clinical method can be quick and brief one, yet it fails in being sensitive enough to detect cases of borderline malnutrition. Moreover, this method is likely to be biased owing to observer differences.

Again, the biochemical tests which have the advantage of being quantitative and fairly accurate, even though expensive, are not quite specific. In contrast physical anthropometry is a simple tool, and indeed a fairly accurate method to assess the nutritional deficiency and overall health status of a community at large. It serves as the most useful screening test especially in developing countries of the world where malnutrition is widely prevalent and the resources are limited. However, because of the heterogenous, climatic, cultural, environmental, religious and socio-economic conditions in our country, no uniformally accepted standards can be laid down. The argument for constructing standards, applicable to the local population groups, has much support than dissent.

With the above background, a planned study on growth and immunization status of pre-school children between the age of 2-5 years was undertaken, keeping the following considerations in view :

1. To establish workable anthropometric standards in children between two to five years of age, which could be applicable to Bundelkhand region.

2. To evaluate the effect of sex and socio-economic structure on various anthropometric measurements.

3. To assess the immunization status of these children during preliminary visits.

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REVIEW OF LITERATURE

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Still in most of the part of the world, the principal health problem is to maintain the health of the people, especially the young children. In the bygone days due to lack of knowledge of modern medical sciences, child health was primarily concerned with the preservation of life. With the increasing knowledge in the field of nutritional requirements for the children and the role of immunization in prevention of various diseases, concept of positive health came into existence.

There are several methods by which the health status of an individual in a community can be assessed. Nutritional anthropometry is one of the simple, practicable and appropriate method for the assessment of health status, especially of young children.

NUTRITIONAL ANTHROPOMETRY.

Nutritional anthropometry is concerned with with measurements of the physical dimensions and gross composition of the human body at different ages. For a field worker, in a developing country like ours, nutritional anthropometry appears to be of great value in the assessment of early growth failure.

Gabriole de Zerbis (1502) first made an attempt to assess the growth pattern by demonstrating certain anatomical differences between an adult and a child.

Three anthropometric measurements have most often been employed in community field surveys for the assessment of nutritional status in early childhood. These were weight, height (length) and arm-circumference (Jelliffe, 1966). In addition, head circumference, chest circumference and triceps-skinfolds have also been usefully included to complete the basic 'six'. These can be compared with the standards if the ages are known (Jelliffe, 1966). Height and head circumference are less affected in acute malnutrition whereas the weight, arm circumference and chest circumference are nutritionally labile. Many investigators have also stressed the importance of calf circumference, thigh circumference and sub-scapular skinfold thickness for the assessment of health status in a community.

For the sake of convenience in the discussion, available studies have been reviewed under following sub-titles.

1. Weight and height.
2. Head and chest circumference.
3. Arm, calf and the thigh circumference.
4. Skinfold thickness.

Weight and Height

Normal birth weight and birth length, at first, were accurately recorded by Roederer (1943). Joseph Clarke (1786) followed up his work and published the observations; he too recorded normal birth-weight, length and head circumference.

Belgian astronomer and statistician Quetelet (1836) was the first investigator who used the term anthropometry for the physical measurements and conducted a complete study of height and weight of male and female subjects of all ages. His data have been used as reference standards for many years.

A longitudinal study of body length of his own son from birth to eighteen years, at six monthly interval was carried out by Count Philibert Guneau de Mount Beilliard in 1777. His observations were published by Buffon (1837). Guillet (1852) first emphasized the importance of periodic weighing of infants and young children, for the evaluation of their general health.

The first Indian study on weight and height measurements was conducted by Dalton (1872) for the assessment of growth of the children and adults. The study did not include infants and young children because it was done mainly to select the tribal people for

military services. Bowditch (1875) undertook a study on the growth of the children in United States, his data have been utilized as the reference standards.

Tables on weight and height of boys and girls of United States were presented by Wood (1918). Baldwin and Wood (1923) revised these tables to present mean weight for age-sex-height groups. Woodbury (1921) compiled weight norms for age-sex-height groups of children between birth and 6 years of age.

'The child's poor growth may offer the first or even the only clinical evidence that abnormality is present', was stated by Boyd (1941, 1944) and he emphasized on the necessity of careful observation of growth in a child.

Clements (1953) expressed that there could be a secular trend in growth, as the mean stature and weight of the children showed increase since 1880. He quoted the observations of Robert (1876) 'A factory child of the present day at the age of 9 years weighs as much as one of 10 years in 1833 ..... Each age has gained one year in 40 years'.

Gomez et al (1955) classified malnutrition on the basis of weight for age using Boston standards. Clinical features like oedema was not taken into consideration since this did not affect the prognosis.

Taking 50th percentile of Boston standard as the base, they classified malnutrition into 3 following groups,

Ist degree - 76% to 85%

IInd degree - 61% to 75%

IIIrd degree - Below 60%

On the question, whether the stature of an adult could be predicted by measurements taken during childhood, Tanner et al (1956) observed that after one year of age, correlation of child's measurements with those of adults increased sharply and reached maximum at 3 years of age. Falkner (1958) examined the London data to verify this hypothesis and observed a high correlation between the adult size and size at three years of age.

Udani (1963) and Currimbhoy (1963) observed wide variations in the weight, height and other measurements in different socio-economic groups. They concluded that growth pattern in children from upper socio-economic group was comparable to the growth pattern seen in Harvard standard.

Anthropometric measurements were used as the basis in assessing the nutritional status of 3,029 Delhi rural pre-school children (Ghai et al, 1968, 1970).

Subsequently a tentative classification of protein calorie malnutrition was drawn by the authors.

Rao et al (1969) studied 3,115 pre-school children in a rural community near Hyderabad. They observed that the mean height and weight of these children were significantly low when compared to the standards.

Wellcome Trust International Working Party (1970) employed weight for classifying malnutrition. They classified malnutrition into 4 groups.

I	:	Below 60% without oedema	- Marasmus.
II	:	Below 60% with oedema	- Marasmic Kwashiorkor.
III	:	60 - 80% with oedema	- Kwashiorkor.
IV	:	60 - 80% without oedema	- Under weight.
		Above 80%	Healthy.

Datta Banik et al (1970) studied the longitudinal growth pattern of pre-school children and its relationship with different socio-economic status. They observed that socio-economic status affected growth pattern of the children considerably. Taluja and Kaul (1970) conducted a survey to study the linear anthropometric measurements. They concluded that average growth of boys was superior to girls at all ages.

The Eighth Report of F.A.O./W.H.O. (1971) Expert Committee on Nutrition emphasized the importance of height measurement since the extent of height deficit, in relation to age, could be regarded as a measure of chronicity of malnutrition. Scone and Lethan (1971) in their study observed that height for age gave information about the state of past nutrition and described that stunting occurred only in chronic malnutrition.

Prasad et al (1971) conducted a cross sectional study of physical growth of pre-school children for 5 measurements viz. height, weight, sitting height, head circumference and chest circumference. They observed that 50th percentile of their study corresponded to 10th percentile of Harvard standard for height and 3rd percentile for weight. A closed relationship between physical growth, socio-economic status and sex was observed.

Chaudhuri et al (1972) examined 1,203 rural pre-school children from the villages of Hougly District. In their study, although urban children were heavier and taller than the rural children, yet 75% of them were below the Harvard standard. Mean height and weight of boys were more than that of the girls throughout the pre-school age-group.

Dhamija et al (1976) selected cases from under 5 clinics and 5 nursery schools of Varanasi. Height (length), weight, head circumference and chest circumference were recorded. A linear correlation between height and weight was observed. Boys, in general, had better growth parameters than the girls.

Naik et al (1976) carried out a study on the anthropometric measurements of 1,670 pre-school children from rural and urban areas of Punjab. Survey showed that the overall average body weight was 75.28% of Harvard standard. The averages for infants (6-12 months), toddlers (13-24 months) and pre-schoolers (25-72 months) were 77.45%, 73.41% and 75.68% of the reference standard respectively. The overall average length was 91.86% of the Harvard standard. The averages for infants, toddlers and pre-schoolers were 94.81%, 91.55% and 90.73 % respectively.

Bhargava et al (1980) conducted a longitudinal study on 220 children from birth to 5 years of age. Infants with a birth weight of 2500 gm. or more were taken for the study. Weight, height (length), and head circumference were measured at specific age intervals. Male infants showed higher values as compared to females, from birth to 6 years of age, for all the parameters considered.

Head and Chest Circumference

Considerable importance has recently been given to the circumference of the head and chest for the assessment of nutritional status. Growth of the head is maximum during infancy and early childhood and it depends mainly upon the growth of the brain tissue.

Falkner (1958) observed that the mean head circumference of boys was constantly higher than that of the girls at all ages, but mean increments were practically identical. Further, that severe degree of malnutrition during infancy and childhood affected adversely the growth and development of brain, has been observed by Stoch et al (1963).

Udani (1963) and Currimbhoy (1963) concluded that the measurements of head and chest circumference were much lower in poor socio-economic group as compared to higher socio-economic group. Differences between head and chest circumference (head circumferenc exceeding the chest circumference) persisted for a longer time in children belonging to lower socio-economic status. Udani (1963) from Bombay inferred that equalization of head and chest circumference occurred at 2 years of age in children belonging to upper socio-economic class and at 2½ to 4 years in children belonging to lower socio-economic class.

Jelliffe (1966) concluded that, in well nourished children, the circumference of the chest became larger than the head circumference, after first 6 months of age.

According to Watson et al (1967), 70% of the growth of the brain occurred during the first year of life and was almost complete at 5-6 years of age. After that there was only a little increase in the size of the brain. Ghai (1968) in a study of Delhi children observed that head and chest circumference ratio became more than one at 10-12 months of age.

Rao et al (1969) from Hyderabad inferred that equalization of head and chest circumference occurred at 2 years in the upper class children and at 24-36 months in the lower class children. In the same study, they observed that the head circumference of the children between 1-5 years of age was 8-10% below the western standards. Chest circumference values were 15-17% below the western standards for age. Srivastava et al (1970), Datta Banik et al (1970), Prasad et al (1971), Sharma et al (1971) and Desai (1971), from their studies, found that the mean head and chest circumference were higher in boys than girls. Head circumference in children from higher socio-economic class showed higher values than those belonging to

low socio-economic class, in the age group of 1-5 years.

Chaudhuri et al (1972) and Mathur et al (1972) observed that chest circumference overtook the head circumference at the age of 2-3 years. Mean values were higher for boys as compared to girls of the same age and overtaking occurred earlier in boys than girls. Dhamija et al (1976), Naik et al (1980) and Shinde et al (1980), in their studies, done in different parts of India, observed that average head and chest circumference of pre-school children were lower than the Harvard standard but were higher or equal to I.C.M.R. standard. Chest circumference overtook the head circumference at the age of 2-3 years except in the study of Shinde et al (1980) who observed that it took place at about one year of age.

Arm, Calf And Thigh Circumference

Arm, calf and thigh circumferences reflect the muscle mass and body stores of calories (subcutaneous fat). Various studies have been conducted to find out a correlation between the nutritional status and these circumferences (Malcolm, 1959; Eksmyr, 1959; Wolanski, 1966; Gopalan, 1968). Malcolm (1959) measured the calf circumference in numerous surveys in Samoa and South Pacific countries

where she observed that typical growth retardation of early childhood was associated with considerable and prolonged reduction is calf girth. Eksmyr (1959), in a study of Ethiopean pre-school children, concluded that the mean arm circumference for age was 98% of the western standards. In the same year, Standard et al (1959) calculated mid-upper arm thickness and muscle bulk from external measurements and radiography in young Jamaican children, hospitalized with severe protein calorie malnutrition. The cases were followed up during recovery phase. They suggested that deficit in muscle mass in comparison to body weight was higher in the malnourished babies as compared to apparently normal children. They also observed that muscle mass measurements increased with nutritional rehabilitation.

Average arm circumference of well nourished Polish children of known age was recorded by Wolanski (1966). A value of 85% of normal arm circumference corresponded to the 3rd percentile in this group of children. A reading below 3rd percentile (i.e. about -2 S.D.) was considered to be abnormal. Various other workers (Kndakis, 1969; Pettit, 1969; Arnhold, 1969; and Burgess et al, 1969) have, however, considered this figure to be too low to demarcate the limits of normality.

Gopalan (1968) noted that assessment on the basis of weight, weight/height^2, calf circumference and arm circumference showed the maximum sensitivity in that order in delineating the normal children from those with protein calorie malnutrition.

Jelliffe and Jelliffe (1969) concluded that, in young children with severe degree of protein calorie malnutrition, limb circumferences were among the most affected body measurements. They also suggested that for survey purpose the modified year constant Wolanski figures could be used for comparison (i.e. 1-2 years '16.0 cm'; 2-3 years '16.25 cm'; 3-4 years '16.5 cm'; and 4-5 years '16.75 cm'. The results of survey could be expressed as (a) mean and standard deviation and (b) grouped in 10% levels below Wolanski standard (Ist level at '80-71%'; IInd level at 70-61% and IIIrd level below 60%).

The mean arm circumference of rural pre-school children of Hyderabad, in age group of 1-5 years, was about 20-30% below the reference standard with most values lying between 70-90%. 2-3% of the children had values below 60% of standards (Rao et al, 1969).

Srivastava et al (1970) observed that in rural pre-school children, average values in calf circumference for boys were higher as compared to

that of the girls. However, growth rate for both the sexes appeared to be identical. Similarly, arm circumference of boys exceeded that of the girls but showed least differences as compared to other measurements. Datta Banik et al (1970) stated that the calf and mid-arm circumferences were higher in children from upper socio-economic groups as compared to those from lower socio-economic groups, in children of 1-5 years of age.

Chaudhuri et al (1972) in a study of rural pre-school children of West Bengal, observed that mid arm-circumference was more in boys than in girls but remained below the western standards, in both the sexes.

Visweswara Rao et al (1978) conducted a study for the comparison of arm and calf circumference as indicators of protein calorie malnutrition. They observed that coefficient of determination of calf circumference with other anthropometric measurements was higher as compared to arm circumference. Calf circumference was found to be a better parameter than the arm circumference in reflecting the protein calorie malnutrition.

Shinde et al (1980) and Mohan et al (1980) in their studies concluded that arm circumference measurement had a significant correlation with socio-economic status and the degree of malnutrition. In their studies boys had higher values for arm circumference than the girls of the comparable age, but these values were much below than the Wolanski standard.

Skinfold Thickness

Skinfold measurement consist of a double layer of skin and subcutaneous fat. Skinfold measurement is the best practical measurement of subcutaneous fat.

Tanner and Whitehouse (1962) measured the skinfold thickness at various sites on the body and developed the standards for British children. They observed that there was a definite trend for girls for being fatter than boys, from birth and onwards.

Various sites for taking measurements of skinfold thickness have been used viz. an average of biceps and triceps (Standard et al, 1959), biceps (Jelliffe and Jelliffe, 1960) and the triceps alone (Jelliffe, 1966). For practical purposes measurements on triceps skinfold are usually preferred as standards are easily available (Jelliffe, 1966).

With considerable variation in fat distribution with age, separate standards are needed for different age groups. Likewise, sex-differences also occur throughout the life with skinfold being greater in girls from birth onwards (Jelliffe, 1966). Appropriate standards for use in communities in developing tropical regions are difficult to lay down with certainity. Jelliffe (1966) recommended that local standards should be prepared and compared with those already available from well fed Caucassian population.

In a study on the pre-school children of previllaged Ethiopean community, mean triceps skinfold thickness was observed to be 86% of the western standards for age (Eksmyr, 1969).

Rao et al (1969) in their study on 3,115 pre-school children in a rural community in Madhya Pradesh, observed that skinfold measurements over triceps were about 30% below the western standards, for all ages. They observed that there was no fall in skinfold thickness with increasing age. Measurements were higher for girls as compared to boys at all the ages, though the differences were not statistically significant.

Chaudhuri et al (1972) in rural pre-school children in West Bengal noted that triceps skinfold measurements were about 30% lower than the western standards. About 390 infants, between the age-groups of 0-12 months of age were studied for triceps skinfold thickness, mid-arm-circumference and weight (Pathak, 1976). He concluded that, at all ages, girls had thicker triceps skinfold than boys. Differences in the sexes were, however, not statistically significant.

Shinde et al (1980) conducted a cross sectional study on 600 pre-school children of upper socio-economic groups and observed that mean skinfold thickness over-left triceps and left subscapular regions were higher in girls than boys. Mean value showed a decline with advancing age and values compared well with Western standards.

IMMUNIZATION STATUS.

Immunization is one of the most cost effective methods in preventing morbidity and mortality in children. Successful prevention of serious communicable diseases by wide-spread use of immunization is necessary to improve the health status of the young children. After long and determined efforts, India, where smallpox till recently was

endemic, has been declared to be smallpox free. Various studies have been done to assess the immunization status of pre-school children in different parts of India (Gupta & Agrawal, 1972; Kumar et al, 1972; Bhandari et al, 1975).

Gupta and Agrawal (1972) studied the importance of parental education and socio-economic status on the immunization status of the children. They observed that in Delhi villages, 95.3% of children had received smallpox, but only 1.2% had received B.C.G. and only 0.6% had been immunized with D.P.T. None had been immunized against Polio. In a study on 2,000 children in villages near Hyderabad city, about 60% of the pre-school children were protected against smallpox but none against the other diseases (Kumar et al, 1972). They also observed that status of immunization and parental awareness for the need of immunization was significantly correlated with socio-economic status of the family.

Gulati et al (1973) in Delhi observed that out of 441 children followed, 381 had received smallpox vaccination, leaving 13.6% of the population unprotected. A definite correlation existed between the literacy of the father and the knowledge in the family about the role of immunization in child health.

In Udaipur district, the immunization status of children was not at all satisfactory (Bhandari et al, 1975). Only 31% of the children had received both smallpox and B.C.G. vaccination, and 10% were immunized against D.P.T. and Polio. Chansoria et al (1975) conducted a study to assess the immunization status of children in a defined area of Jabalpur Cantonment. Percentage rate of vaccination was 97.3% for smallpox, 2.3% for B.C.G., 11.9% for D.P.T. and 9.7% for Polio. Immunization status was significantly correlated to the maternal literacy status. Infants delivered at private nursing homes had a higher rate of vaccination.

Philip et al (1976) in a study of rural area in Kerala, observed that percentage rate of immunization for smallpox, B.C.G., tripple and polio vaccines were 73%, 50%, 12% and 18% respectively. Immunization status was found to be related significantly to maternal literacy and socio-economic status. Hooja et al (1976) observed that B.C.G. was least accepted (35.5%) and smallpox was most accepted (95.4%) immunization in a Delhi community; 54.8% and 60.9% of the children had received D.P.T. and Polio vaccination respectively. A direct correlation of immunization status was observed with socio-economic status and maternal literacy.

Sharma et al (1977) investigated 1,200 urban and 1,000 rural mothers for immunization status of their children below 5 years of age, in Jammu. More males than females were immunized against smallpox and B.C.G. B.C.G. and tripple vaccination appeared to be related to socio-economic status and the levels of maternal literacy. About 80% of the urban and 73% of the rural children had received primary vaccination against smallpox. Percentages of vaccinated population against B.C.G., tripple and polio were 14%, 15% and 25% respectively for urban children; these figures were 5%, 5% and 8% respectively for rural children.

In a cross sectional, door to door, survey carried out at Agra, Kumar et al (1978) revealed that immunization status in both urban and rural infants, was far from being called as even satisfactory. In general, more cases were immunized for B.C.G. as compared to tripple and polio vaccines. Out of 4,410 cases, 86.3% urban and 97.5% rural infants had not received B.C.G., tripple or polio vaccine. There was a relatively greater awareness, among the families of higher social classes for immunization.

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MATERIAL AND METHODS

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The study on anthropometric measurements and immunization status, which included children within the age-group of 2-5 years from different sources, was carried out from February to December, 1980. The study included 1,040 pre-school children from following sources :

1. From the villages, situated within a radius of 10 kilometers from M.L.B. Medical College, Jhansi (U.P.).
2. From various nursery schools, located in Jhansi (U.P.).
3. From the Well Baby Clinic, Department of Paediatrics, M.L.B. Medical College, Jhansi (U.P.).
4. From the colony of Parichha, Jhansi (U.P.).

1. Villages :- Four villages, Karganwa, Pichhore, Bhagwantpura and Digara were selected for the study. All of them were situated within the radius of 10 kilometers from the medical college, Jhansi. A door to door survey was done. An attempt was made to approach each family and all the children between

the age-group of 2-5 years were examined except a few which could not be examined due to non-availability at home or non-cooperation of parents.

2. Nursery Schools :- An independent approach through the heads of the institutions was made, and the children between the age-group of 2-5 years were assessed. Following nursery schools of the city were selected for the study.

(i) Janta English School.

(ii) St. John's School.

(iii) B.T.C. training and nursery school.

(iv) Montessory School (Sadar Bazar).

(v) Saraswati Shishu Mandir.

3. Well Baby Clinic :- The children between the age-group of 2-5 years, coming to the Department of Paediatrics for health check up, immunization were taken up for the study.

4. Parichha Colony :- It is located at about 14 kilometers from medical college, on Jhansi-Kanpur road. A Thermo-electric Power Project is under construction at that place. Through a door to door survey, children from 2-5 years of age were examined.

A detailed proforma was designed in order to record the relevant details about each child. Facts recorded were similar in all the cases. For children examined in Nursery schools, a visit to home was done to ascertain the facts in history from their parents. Besides name, age, sex and religion, following facts were recorded in each case.

Date of Birth

Exact date of birth was extracted from the parents, upto the level, as far as, possible. In those cases taken from the schools, ages were noted from the school records and later on, confirmation was done from their parents. In pre-school children taken from villages, date of birth was recorded according to local events and from local calenders, within a limit of ± 15 days. Confirmation by personal inspection was insisted upon in those cases where documentary evidences, in the form of diary notes, hospital discharge certificate and Gram Panchayat records were available. In cases of any discrepancy, clarification was sought from the parents.

Socio-economic Status

Total yearly income of the family was enquired and per-capita income per month was calculated.

Families were divided into following two social class groups, using criterion, suggested by Prasad (1970).

Group-A : It included those families belonging to upper two classes (Social classes I & II) and in which monthly per capita income was rupees 150.00 or more.

Group-B : It consisted of those children which were from the families, classified in IIIrd, IVth and Vth social classes; monthly per-capita income was rupees 149 or less.

Dietary history was recorded with an special attention on the following points.

(a) The age till which breast milk was given and if not, then why ?

(b) Age at which artificial milk was started, type of artificial milk given and its dilution.

(c) Age of weaning.

(d) Whether the family was vegetarian or otherwise.

Antenatal, Natal and Post-natal history

Relevant antenatal, natal and post-natal history was recorded and the children with severe birthanoxis, cyanosis, jaundice and mental retardation were excluded from the study.

Past History : Efforts were made to find out the occurrence of any chronic illness in the past, that might have affected the growth and development. Enquiry was made, especially to find out the history suggestive of tuberculosis, chronic diarrhoea, convulsions, whooping cough, tetanus, measles, mumps, diphtheria, chronic chest infections and worm infestations. When there was history suggestive of meningitis, encephalitis, or long term steroid therapy, such cases were discarded from the study.

Family history : An enquiry was made about the history of any familial illness and tuberculosis.

Mile stones : A few mile stones were recorded and the age at which child attained them were enquired. Mile stones recorded were, social smile, head control, sitting, crawling, standing without support and walking. Any departure from the normal was carefully scrutinized for its cause.

Immunization status

History of immunization was taken from the parents or family members. For smallpox and B.C.G., confirmation was done by careful inspection of scar marks. For D.P.T. and Polio vaccination, however, verbal statements by parents were relied upon. If any record was available, confirmation was done by personal inspection.

Physical Examination : A thorough clinical examination was made at the time when anthropometric measurements were taken. Children with congenital heart disease and chronic illness (specially tuberculosis) were excluded from the study. An attempt was made to detect the signs of any specific deficiency.

Following scheme was adopted for examination.

Nutrition - Signs of general malnutrition were sought with Pallor, oedema, skin changes and hair changes were recorded. Eyes were examined for the presence of xerosis and bitot's spots. Skin was examined for any evidence of nasolabial dysebacea, xerosis, hypopigmentation, hyperkeratoris and any dermatosis.

Lips, gums and tongue were examined for the presence of angular lesions, chelosis, gums swelling, glossitis and papillary atrophy of tongue.

Skeletal system was examined for the presence of any deformity and signs of rickets such as craniotabes, cranial bossing, costo-chondral beading, epiphysial widening, bowing of legs etc. Thyroid gland was specially examined to find out any abnormality.

Systemic examination was made and cardiovascular system, respiratory system, central nervous system and abdomen were examined thoroughly to detect abnormality, if any.

Anthropometric Measurements

Weight :- Weight was recorded by using spring weighing machine. It was regularly checked up for its accuracy and error, if any, was corrected before weighing, each time. Weight was recorded nearest to 0.25 kg. For those children who could not stand, infant weighing machine was used, capable of taking weight upto 10 kg. nearest to 0.05 kg. Same machines were used every time to minimize the error.

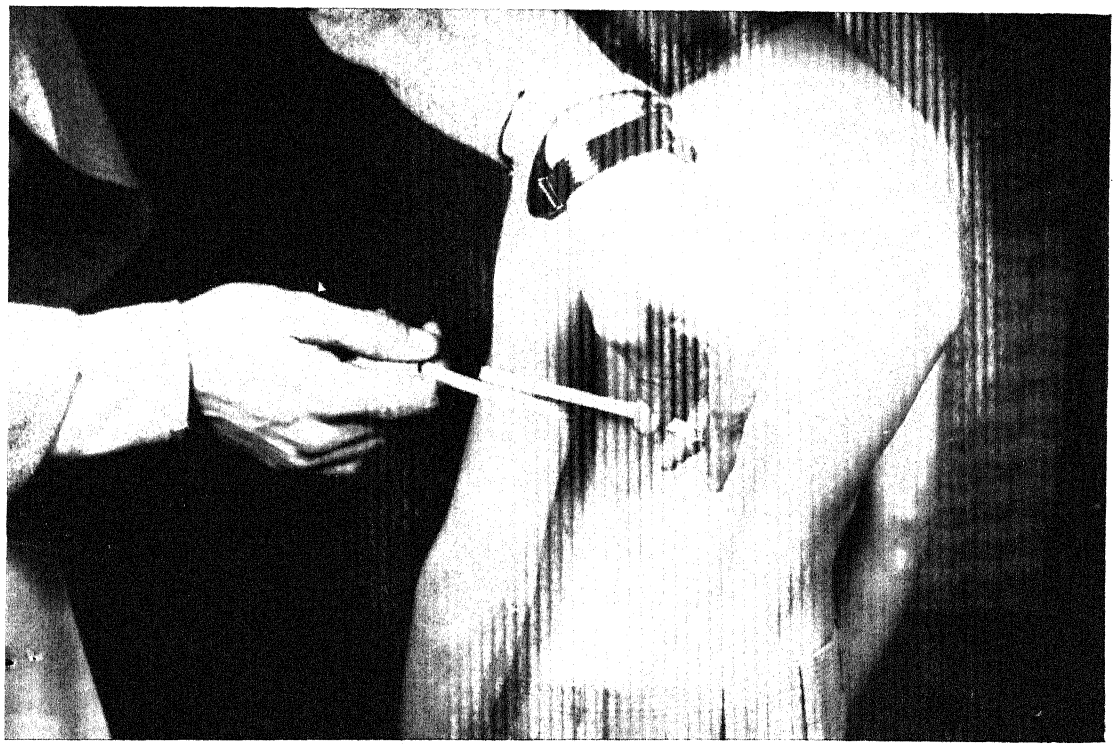
In order to have uniformity in procedure, children were weighed with minimum possible clothings. In older children a suitable deduction in weight was made, for clothings.

Height/Length :- Standing height was taken by a specially designed stadiometer. Height was recorded

to 0.1 cm. The child was made to stand on the platform of the scale, without shoes and shocks, heals touching each other, and toes separated at an angle of 45°. The child was asked to stretch his neck to be as tall as possible, without lifting the heals. The head was positioned so that the child looked straight, his head being in Frankfurt plane. Gentle but firm traction was applied under the mastoid process to help to stretch the neck, without lifting the heals, and the horizontal flat board was brought down over the head to rest just above it. Two or more times such measurements were done, till the board compressed the hair, over the scalp; and final reading was recorded nearest to 0.1 cm.

For recumbant length, the child was made to lie supine on the table or on the flat surface, with the scale by the side. Head was positioned in the middle in contact with the fixed board on one end, keeping the Frankfurt plane vertical. The child's head was held firmly in the position by mother or any other person. Then the legs were straightened, feet turned at right angle to the legs and sliding board was brought about in contact with the sole of the foot.

Head circumference : The head circumference was measured with a narrow, flexible, steel tape. Head was



PHOTOGRAPH SHOWING TECHNIQUE OF MID-ARM

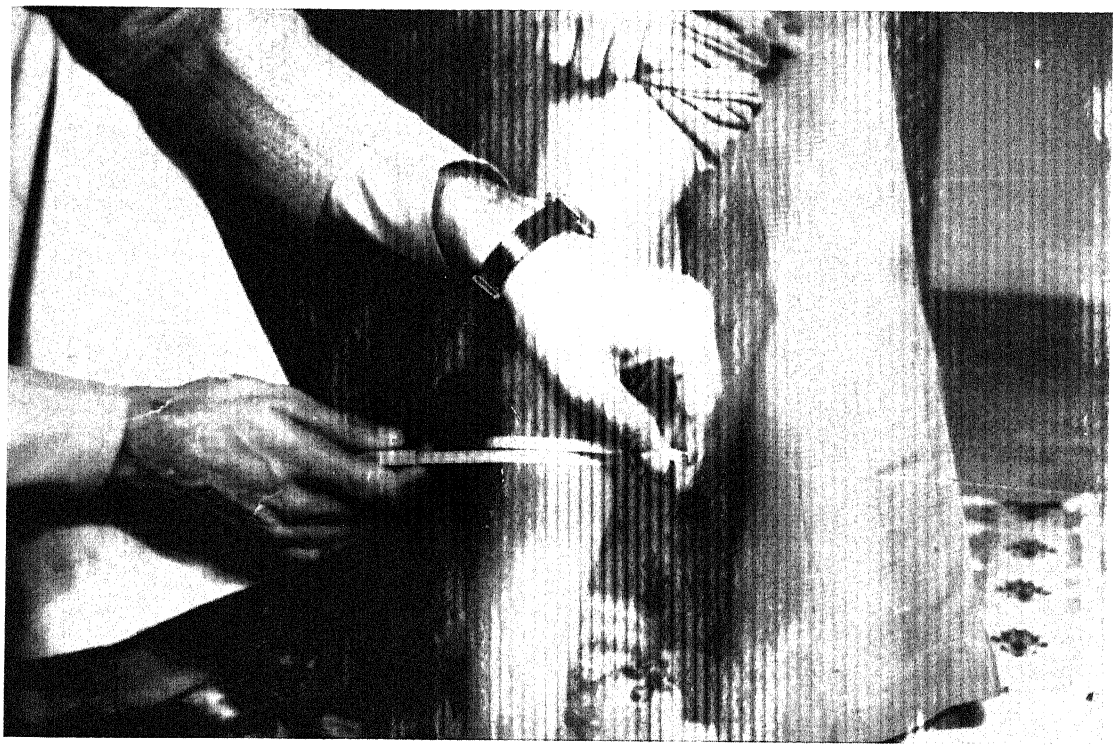
CIRCUMFERENCE MEASUREMENT

steadied and tape was placed firmly round it so that it was on the frontal bone, just above supra-orbital margins anteriorly, above the ears laterally at the same level and over the maximum occipital protuberance posteriorly. Tape was made sufficiently tense to crush the hair against the skull and two ends were brought together on one side of the skull before recording the reading to the nearest 0.1 cm.

The Chest circumference : The same flexible, non-stretch steel tape was used, and measurement was made at the nipple line. Mean of the maximum and minimum circumferences (during the two phases of respiration) was taken and readings were recorded to the nearest 0.1 cm.

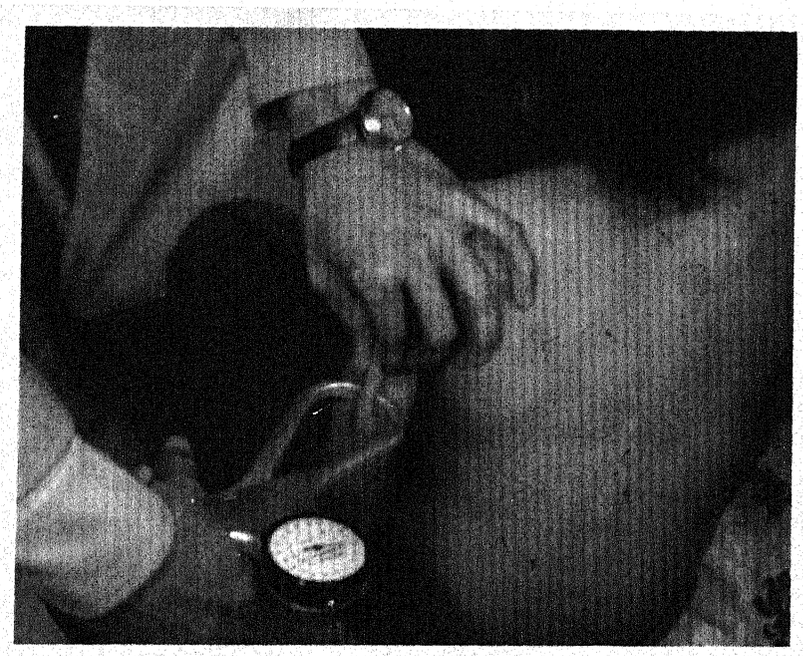
Mid-arm circumference : Circumference of left upper arm at the point mid-way between acromian process of scapula and olecranon process of ulna, was measured, while arm was hanging freely. Same steel tape was placed gently but firmly, round the limb to avoid compression of the soft tissues. To avoid the error, reading was taken against 10 cm. mark, nearest to 0.1 cm. Later on 10 cm. was deducted from the reading.

Mid Thigh circumference : Left mid thigh circumference was measured at the point mid way between the anterior superior iliac spine and medial epicondyle of femur.



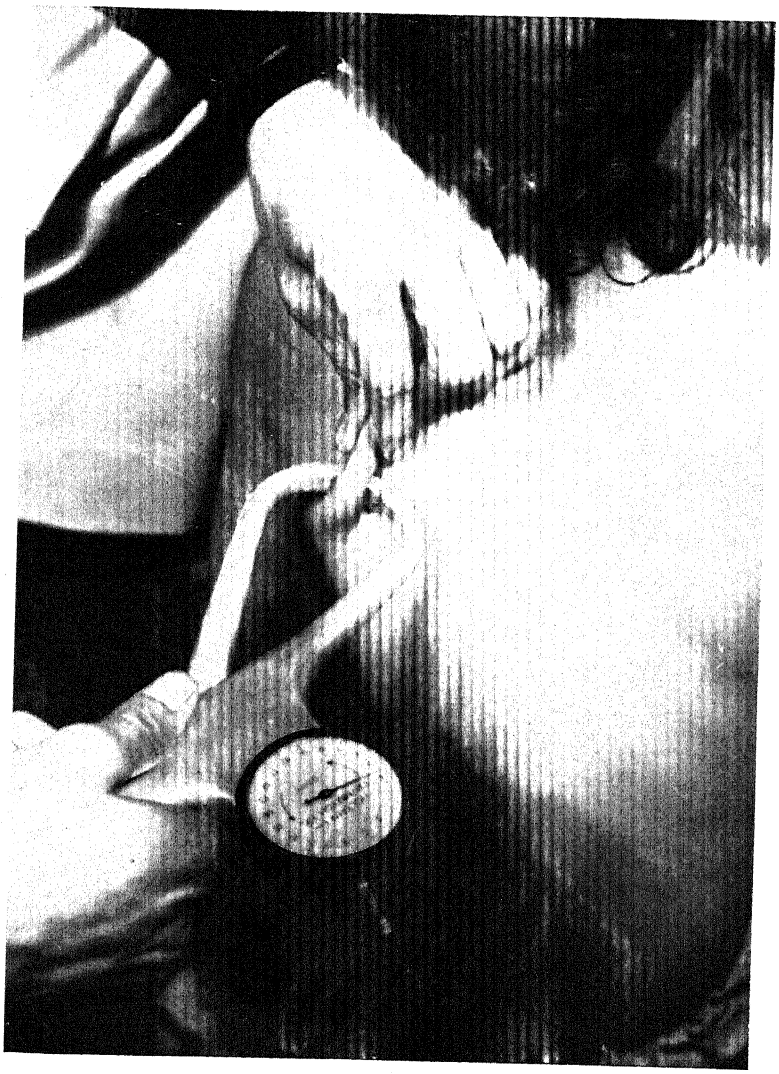
PHOTOGRAPH SHOWING TECHNIQUE OF CALF

CIRCUMFERENCE MEASUREMENT



PHOTOGRAPH SHOWING TECHNIQUE OF TRICEPS

SKINFOLD THICKNESS MEASUREMENT



PHOTOGRAPH SHOWING TECHNIQUE OF SUB-SCAPULAR SKINFOLD THICKNESS MEASUREMENT

To avoid the compression of soft tissues, tape was placed gently but firmly and reading was recorded to the nearest 0.1 cm.

Calf circumference : In the same manner maximum calf circumference of the left leg was measured. Compression of soft tissues was avoided. Reading was recorded nearest to 0.1 cm., with the same flexible steel tape.

Triceps skinfold thickness : Triceps skinfold thickness was measured by using the Harpenden caliper. The site was carefully selected, mid way, down the arm (left), between the acromian process of scapula and olecranon process of ulna. Arm was hanging relaxed on the sides.

The skinfold parallel to the long axis was picked up between the thumb and forefinger of the left hand. Underlying muscles were cleared away and thickness at this point was measured. Reading was recorded nearest to 0.1 mm.

Sub-scapular skinfolds thickness : The subscapular skinfold was measured with Harpenden caliper, just medial to the angle of left scapula. The fold was kept in a line approximately 45° to the spine in the natural line of skin cleavage. The readings were recorded nearest to 0.1 mm.

Statistical analysis was done in terms of mean and standard deviation. For statistical significance 't' test was applied.

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OBSERVATIONS

OBSERVATIONS

The present work on growth and immunization status of pre-school children was undertaken on 1,040 children, taken from 4 different sources, namely - The Well Baby Clinic in the Department of Paediatrics, M.L.B. Medical College, Jhansi, Parichha Colony (an urban settlement), Jhansi, a rural community consisting of 4 villages in the district of Jhansi and 5 Nursery schools, situated in the city of Jhansi.

Table I shows the number of children considered from various sources. Out of 1,040 children studied, 450 (43.3%) belonged to rural community, followed by 366 (35.2%) from schools, 130 (12.5%) from the Well Baby Clinic and 94 (9.0%) from the Parichha colony. Growth profile of these children was studied considering the following anthropometric measurements; weight and height; head, chest, mid-arm, mid-thigh and calf circumferences; sub-scapular and triceps skinfold thickness.

TABLE I.

Distribution of the children studied from different sources.

Name of the source	Well Baby Clinic	School	Parichha colony	Village	Total
No. of children	130	366	94	450	1,040
%	12.50	35.19	9.04	43.27	100.00

AGE, SEX AND SOCIO-ECONOMIC STATUS.

Table II shows the distribution of the children according to sex and socio-economic status at 6 monthly age intervals. The ratio of boys and girls and of children from lower and upper socio-economic groups was approximately 1 : 1. There were 521 (50.1%) boys against 519 (49.9%) girls. The number of children in upper and lower socio-economic groups was 530 (51%) and 510 (49%) respectively.

TABLE II.

Age and sex distribution of the children according to socio-economic status.

Age (months)	Lower socio-economic status			Upper socio-economic status			Total		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
24 - 30	48	41	89	40	35	75	88	76	164
30 - 36	39	43	82	42	47	89	81	90	171
36 - 42	32	41	73	45	40	85	77	81	158
42 - 48	30	44	74	42	43	85	72	87	159
48 - 54	41	37	78	48	45	93	89	82	171
54 - 60	66	48	114	48	55	103	114	103	217
Total	256	254	510	265	265	530	521	519	1,040

TABLE III

Significance of difference of weight (kg.) in different socio-economic groups by age.

Age (months)	BOYS				Statistical significance		GIRLS				Statistical significance	
	Group A		Group B		't' value	P value	Group A		Group B		't' value	P value
	No.	Mean±SD	No.	Mean±SD			No.	Mean ± SD	No.	Mean±SD		
24 - 30	40	10.67±1.45	48	8.29±0.92	8.98	<0.001	35	8.62±1.42	41	8.05±0.90	2.05	<0.05
30 - 36	42	12.39±1.33	39	9.38±1.05	11.34	<0.001	47	11.95±1.14	43	8.93±0.85	14.73	<0.001
36 - 42	45	13.22±1.14	32	11.49±1.16	6.49	<0.001	40	12.99±1.49	41	10.95±0.66	7.93	< 0.001
42 - 48	42	13.35±1.25	30	11.84±0.76	6.35	<0.001	43	13.01±1.43	44	12.05±1.16	3.44	<0.001
48 - 54	48	13.94±1.03	41	12.87±0.88	5.28	<0.001	45	13.94±1.23	37	12.68±0.91	5.32	<0.001
54 - 60	48	14.75±1.10	66	13.37±0.84	7.28	<0.001	55	14.22±1.16	48	13.59±0.90	3.10	<0.01

Group A = Upper socio-economic status; Group B = Lower socio-economic status.

TABLE IV

Significance of difference of weight (kg.) in two sexes by age.

Age (months)	GROUP A				Statistical significance		GROUP B				Statistical significance	
	Boys		Girls		't' value	P value	Boys		Girls		't' value	P value
	No.	Mean±S D	No.	Mean±SD			No.	Mean±SD	No.	Mean±SD		
24 - 30	40	10.67±1.45	35	8.62±1.42	6.17	<0.001	48	8.29±0.92	41	8.05±0.90	1.24	>0.10
30 - 36	42	12.39±1.33	47	11.95±1.14	1.66	>0.05	39	9.38±1.05	43	8.93±0.85	2.12	<0.05
36 - 42	45	13.22±1.14	40	12.99±1.49	0.79	>0.10	32	11.49±1.16	41	10.95±0.66	2.35	< 0.05
42 - 48	42	13.35±1.25	43	13.01±1.43	1.16	>0.05	30	11.84±0.76	44	12.05±1.16	0.94	> 0.10
48 - 54	48	13.94±1.03	45	13.94±1.23	Nil	Nil	41	12.87±0.88	37	12.68±0.91	0.93	> 0.10
54 - 60	48	14.75±1.10	55	14.22±1.16	2.37	<0.05	66	13.37±0.84	48	13.59±0.90	1.32	> 0.10

Group A = Upper socio-economic status ; Group B = Lower socio-economic status.

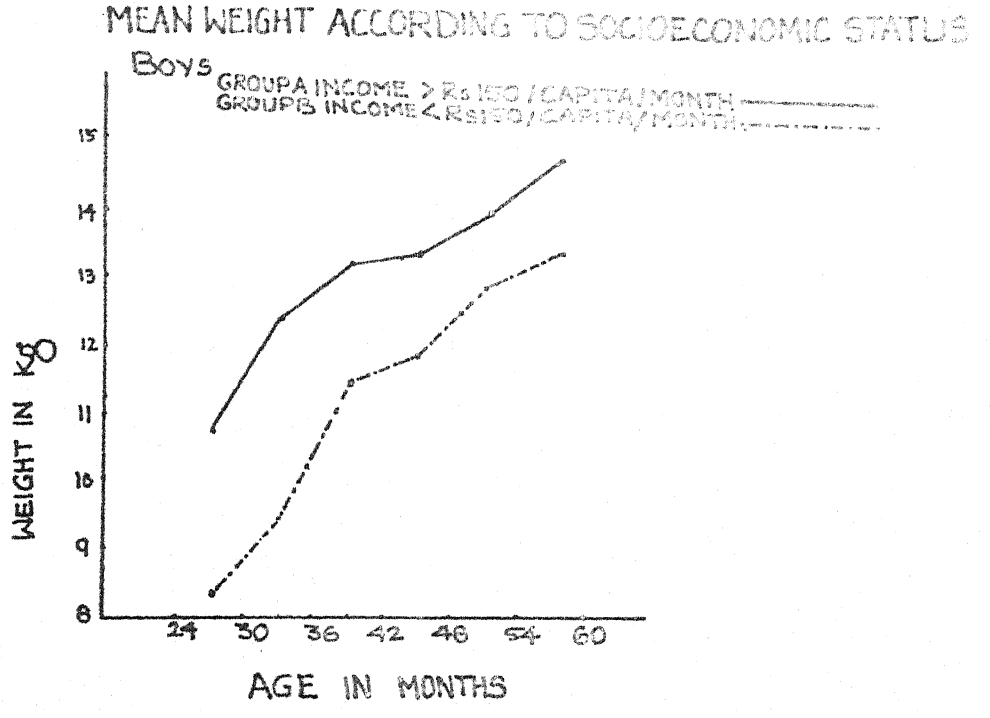
MEAN WEIGHT ACCORDING TO SOCIOECONOMIC STATUS
Boys
GROUP A INCOME > Rs 150 / CAPITA / MONTH
GROUP B INCOME < Rs 150 / CAPITA / MONTH
WEIGHT IN KG
15
14
13
12
11
10
9
8
24
30
36
42
48
54
60
AGE IN MONTHS

Fig. 1.

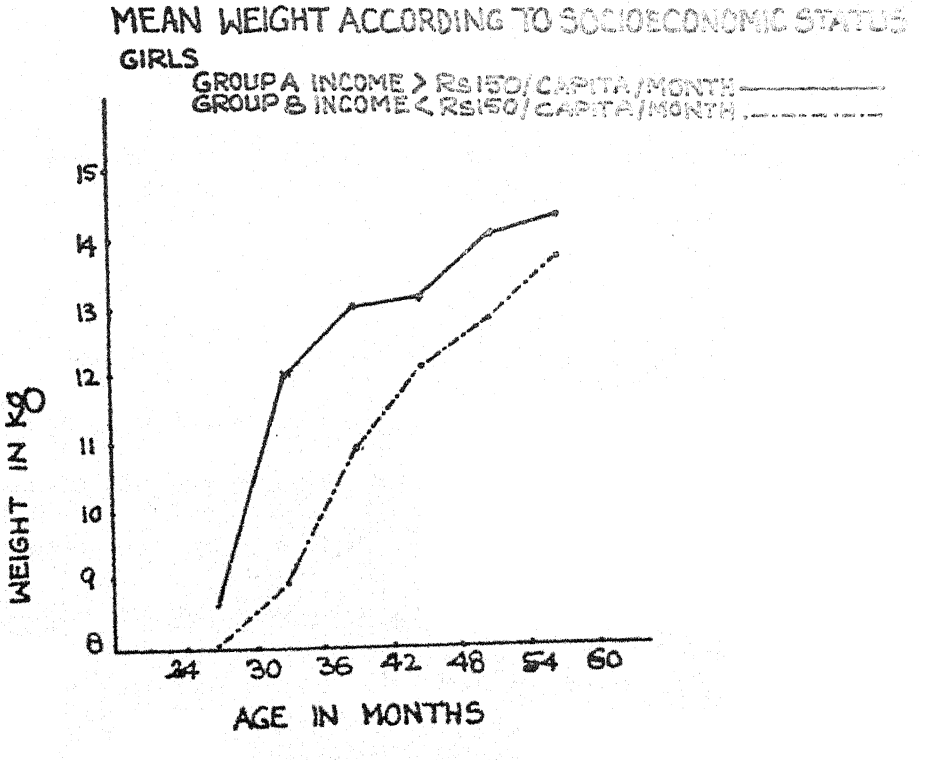
MEAN WEIGHT ACCORDING TO SOCIOECONOMIC STATUS
GIRLS
GROUP A INCOME > Rs 150 / CAPITA / MONTH
GROUP B INCOME < Rs 150 / CAPITA / MONTH
WEIGHT IN KG
15
14
13
12
11
10
9
8
24
30
36
42
48
54
60
AGE IN MONTHS

Fig. 2.

ANTHROPOMETRIC MEASUREMENTS.

Measurements of weight, height, head circumference, chest circumference, mid-arm circumference, mid-thigh circumference, calf circumference, sub-scapular and triceps skinfold thickness of 1,040 children were statistically analysed. Mean and standard deviation (S.D.) values were derived for individual measurements for two sexes and socio-economic groups (A and B). These have been shown in Tables III to XX.

Sex, Socio-economic Status and Weight

Table III shows mean weight of boys and girls in different socio-economic groups by age. Mean weight of boys of group A was significantly more than that of boys of group B for all age-groups. Similarly, mean weight of girls of group A was also significantly higher than that of the girls of group B for all age-groups. Mean weight showed a consistent increase with age for boys and girls separately (Fig. 1 and Fig. 2).

From Table IV, it is evident that in group A, mean weights of boys and girls were more or less similar for all ages except two extreme age-groups in which boys had higher weight than girls. Similarly, mean weight of boys and girls did not differ significantly for all the ages except in the age-group 30-42 months, where boys had higher values of weight than girls.

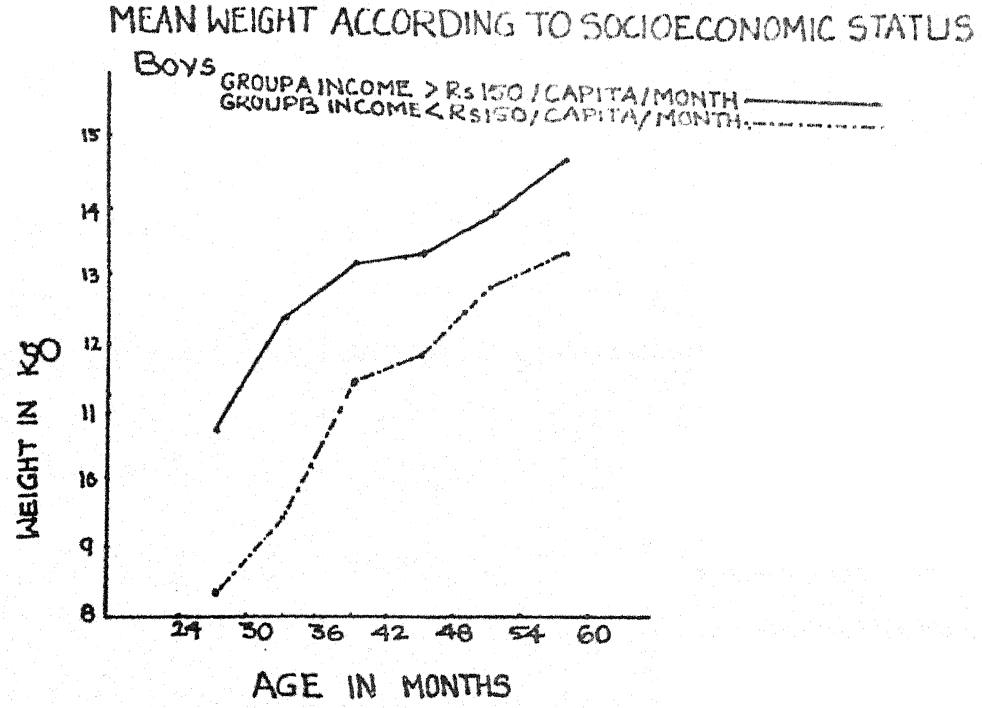
MEAN WEIGHT ACCORDING TO SOCIOECONOMIC STATUS
Boys
GROUP A INCOME > Rs 150 / CAPITA / MONTH
GROUP B INCOME < Rs 150 / CAPITA / MONTH
WEIGHT IN KG
15
14
13
12
11
10
9
8
24
30
36
42
48
54
60
AGE IN MONTHS

Fig. 1.

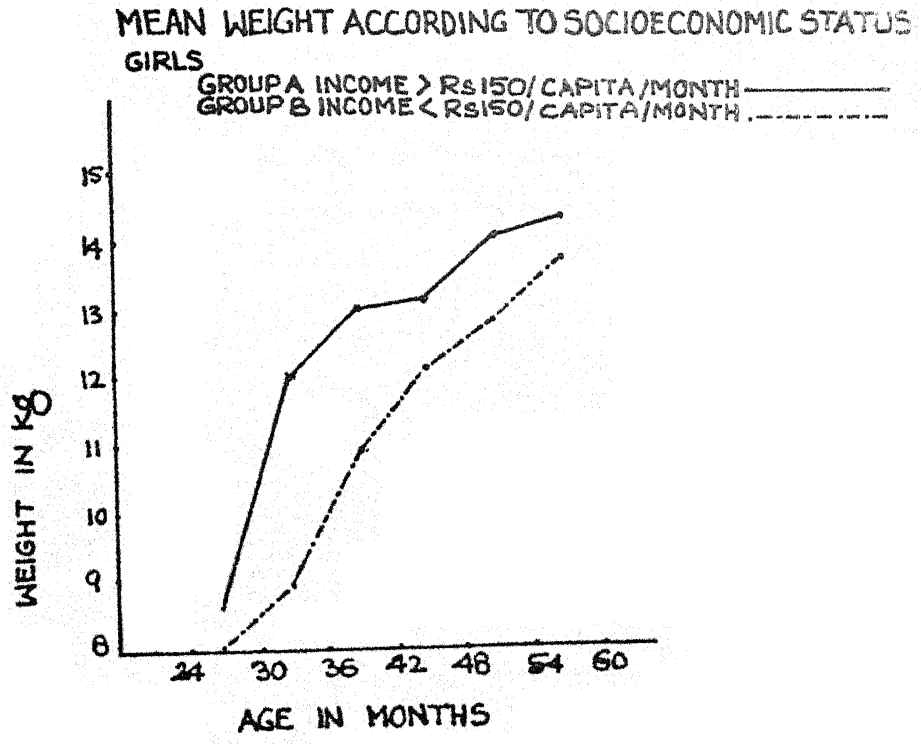
MEAN WEIGHT ACCORDING TO SOCIOECONOMIC STATUS
GIRLS
GROUP A INCOME > Rs 150 / CAPITA / MONTH
GROUP B INCOME < Rs 150 / CAPITA / MONTH
WEIGHT IN KG
15
14
13
12
11
10
9
8
24
30
36
42
48
54
60
AGE IN MONTHS

Fig. 2.

ANTHROPOMETRIC MEASUREMENTS.

Measurements of weight, height, head circumference, chest circumference, mid-arm circumference, mid-thigh circumference, calf circumference, sub-scapular and triceps skinfold thickness of 1,040 children were statistically analysed. Mean and standard deviation (S.D.) values were derived for individual measurements for two sexes and socio-economic groups (A and B). These have been shown in Tables III to XX.

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From Table IV, it is evident that in group A, mean weights of boys and girls were more or less similar for all ages except two extreme age-groups in which boys had higher weight than girls. Similarly, mean weight of boys and girls did not differ significantly for all the ages except in the age-group 30-42 months, where boys had higher values of weight than girls.

TABLE V

Significance of difference of height (cm.) in different socio-economic groups by age.

Age (months)	BOYS				Statistical significance		GIRLS				Statistical significance	
	Group A		Group B		't' value	P value	Group A		Group B		't' value	P value
	No.	Mean±SD	No.	Mean±SD			No.	Mean±SD	No.	Mean±SD		
24 - 30	40	82.89±4.83	48	72.20±3.73	11.44	<0.001	35	70.92±5.93	41	70.55±5.13	0.28	>0.10
30 - 36	42	88.58±5.52	39	76.42±4.48	10.92	<0.001	47	85.75±5.03	43	72.75±3.74	13.98	<0.001
36 - 42	45	91.10±4.52	32	82.68±6.12	6.60	<0.001	40	89.93±4.26	41	77.00±2.86	15.99	<0.001
42 - 48	42	94.72±5.27	30	82.94±4.81	9.43	<0.001	43	91.16±4.91	44	83.02±5.47	7.31	<0.001
48 - 54	48	98.86±4.08	41	87.98±5.81	10.05	<0.001	45	94.17±5.71	37	89.77±6.65	3.17	<0.01
54 - 60	48	100.69±4.81	66	94.97±5.00	6.16	<0.001	55	98.82±5.20	48	96.66±5.45	2.05	<0.05

Group A = Upper socio-economic status ; Group B = Lower socio-economic status.

TABLE VI

Significance of difference of height (cm.) in two sexes by age.

Age (months)	GROUP A				Statistical significance		GROUP B				Statistical significance	
	Boys		Girls		't' value	P value	Boys		Girls		't' value	P value
	No.	Mean±SD	No.	Mean±SD			No.	Mean±SD	No.	Mean±SD		
24 - 30	40	82.89±4.83	35	70.92±5.93	9.49	<0.001	48	72.20±3.73	41	70.55±5.13	1.70	>0.05
30 - 36	42	88.58±5.52	47	85.75±5.03	2.51	<0.05	39	76.42±4.48	43	72.75±3.74	4.00	<0.001
36 - 42	45	91.10±4.52	40	89.93±4.26	1.22	>0.10	32	82.68±6.12	41	77.00±2.86	4.85	<0.001
42 - 48	42	93.39±9.98	43	91.16±4.91	1.30	>0.10	30	82.94±4.81	44	83.02±5.49	0.06	>0.10
48 - 54	48	98.86±4.08	45	94.17±5.71	4.53	<0.001	41	87.98±5.81	37	89.77±6.65	1.26	>0.10
54 - 60	48	100.69±4.81	55	98.82±5.20	1.89	>0.05	66	94.97±5.0	48	96.66±5.45	1.69	>0.05

Group A = Upper socio-economic status ; Group B = Lower socio-economic status.

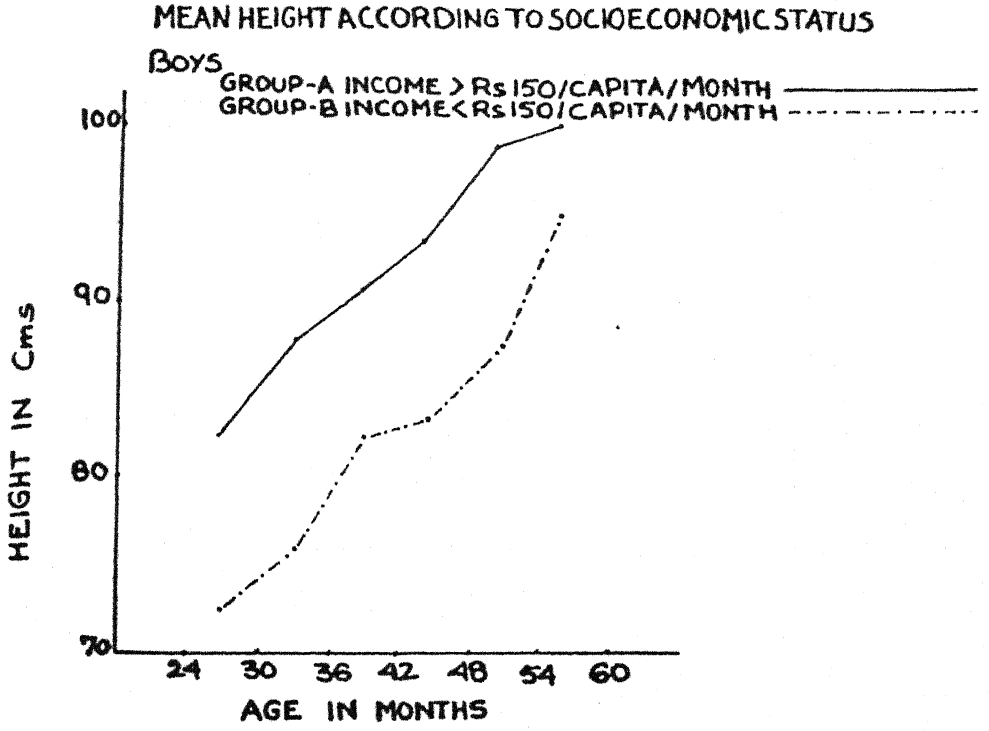
MEAN HEIGHT ACCORDING TO SOCIOECONOMIC STATUS
BOYS
GROUP-A INCOME > Rs 150/CAPITA/MONTH
GROUP-B INCOME < Rs 150/CAPITA/MONTH
HEIGHT IN Cms
100
90
80
70
24
30
36
42
48
54
60
AGE IN MONTHS

Fig. 3.

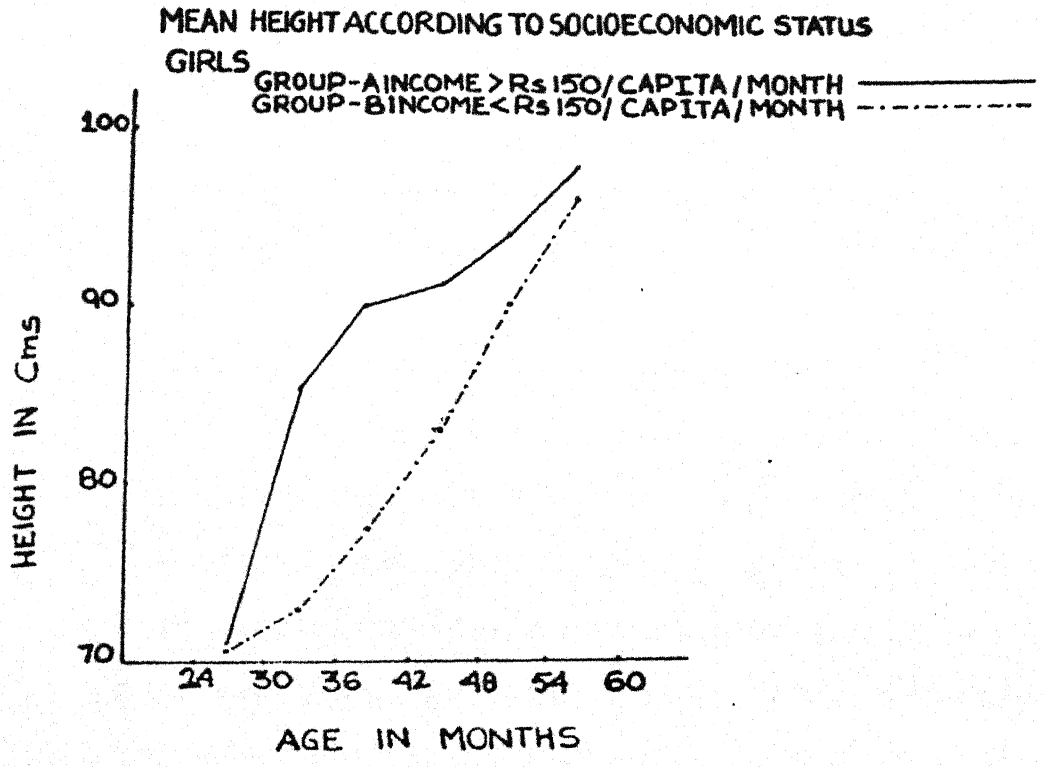
MEAN HEIGHT ACCORDING TO SOCIOECONOMIC STATUS
GIRLS
GROUP-A INCOME > Rs 150/ CAPITA / MONTH
GROUP-B INCOME < Rs 150/ CAPITA/ MONTH
HEIGHT IN Cms
100
90
80
70
24
30
36
42
48
54
60
AGE IN MONTHS

Fig. 4.

Sex, Socio-economic Status and Height

Height in relation to socio-economic groups and sex has been shown in Tables V and VI. Table V shows that mean height of boys in group A was significantly higher than those in group B for all ages. Mean height of girls in group A was also observed to be significantly more than that of girls in group B at all ages except in the age-group 24-30 months where the difference was not statistically significant.

From Table VI, it is evident that mean height of boys was more than girls in group A for age-group 24-36 months and 48-54 months. In group B also, mean height of boys was more than that of the girls for age-group 30-42 months. For the other age-groups, both sexes had nearly equal mean heights. Fig. 3 and 4 clearly indicate that height for both boys and girls showed an increasing trend with age for two socio-economic groups, separately.

Sex, Socio-economic Status and Head Circumference

Head circumference in relation to two socio-economic groups and sexes has been shown in Tables VII and VIII. From Table VII, it is clear that in group A, head circumference was more in boys than those in group B at all ages. In case of girls, head circumference values were higher for upper socio-economic group than

TABLE VII

Significance of difference of head circumference (cm.) in different socio-economic groups by age.

Age (months)	BOYS						GIRLS					
	GROUP A		GROUP B		Statistical significance		GROUP A		GROUP B		Statistical significance	
	No.	Mean±SD	No.	Mean±SD	't' value	P value	No.	Mean±SD	No.	Mean±SD	't' value	P value
24 - 30	40	42.52±0.76	48	44.54±0.69	6.27	<0.001	35	44.13±0.93	41	44.18±0.83	0.24	>0.10
30 - 36	42	46.35±1.28	39	45.51±1.03	3.26	<0.01	47	46.43±1.06	43	43.67±0.88	13.48	<0.001
36 - 42	45	47.32±1.02	32	46.53±1.15	3.11	<0.01	40	47.20±0.54	41	49.55±0.94	7.89	<0.001
42 - 48	42	48.09±0.88	30	46.93±1.17	4.58	<0.001	43	47.51±1.05	44	46.63±2.90	1.89	>0.05
48 - 54	48	48.61±1.13	41	47.52±1.01	4.80	<0.001	45	47.40±1.22	37	47.35±0.96	0.20	>0.10
54 - 60	48	48.95±1.35	66	47.35±5.39	2.31	<0.05	55	48.08±1.28	48	48.25±1.15	0.71	>0.10

Group A = Upper socio-economic status ; Group B = Lower socio-economic status.

TABLE VIII

Significance of difference of head circumference (cm.) in two sexes by age.

Age (months)	GROUP A				Statistical significance		GROUP B				Statistical significance	
	BOYS		GIRLS		't' value	P value	BOYS		GIRLS		't' value	P value
	No.	Mean±SD	No.	Mean±SD			No.	Mean±SD	No.	Mean±SD		
24 - 30	40	45.52±0.76	35	44.13±0.93	7.02	<0.001	48	44.54±0.69	41	44.18±0.83	2.20	<0.05
30 - 36	42	46.35±1.28	47	46.43±1.06	0.31	>0.10	39	45.51±1.03	43	43.67±0.88	8.65	<0.001
36 - 42	45	47.32±1.02	40	47.20±0.94	0.56	>0.10	32	46.53±1.15	41	45.55±0.94	3.90	<0.001
42 - 48	42	48.09±0.88	43	47.51±1.05	2.76	<0.01	30	46.93±1.17	44	46.63±2.90	0.61	>0.10
48 - 54	48	48.61±1.13	45	47.40±1.22	4.95	<0.001	41	47.52±1.01	37	47.35±0.96	0.76	>0.10
54 - 60	48	48.95±1.35	55	48.08±1.28	3.34	<0.01	66	47.35±5.39	48	48.25±1.15	1.31	>0.10

Group A = Upper socio-economic status ; Group B = Lower socio-economic status.

TABLE IX

Significance of difference of chest circumference (cm.) in different socio-economic groups by age.

Age (months)	BOYS				Statistical significance		GIRLS				Statistical significance	
	GROUP A		GROUP B		't' value	P value	GROUP A		GROUP B		't' value	P value
	No.	Mean±SD	No.	Mean±SD			No.	Mean±SD	No.	Mean±SD		
24 - 30	40	46.11±1.32	48	43.57±1.56	8.27	<0.001	35	44.13±0.93	41	43.48±1.39	2.42	<0.05
30 - 36	42	48.30±1.66	39	44.56±1.75	4.08	<0.001	47	47.17±1.91	39	43.67±1.75	8.85	<0.001
36 - 42	45	49.08±1.67	32	47.42±1.63	4.35	<0.001	40	48.63±2.10	41	46.29±1.32	5.98	<0.001
42 - 48	42	50.12±2.34	30	48.06±2.26	3.75	<0.001	43	45.05±2.46	44	47.59±1.51	3.32	<0.01
48 - 54	48	50.70±2.56	41	49.14±1.58	3.51	<0.001	45	48.80±1.86	37	48.70±1.33	0.28	>0.1
54 - 60	48	51.56±2.62	66	49.86±1.99	3.77	<0.001	55	50.72±2.32	48	50.54±1.60	0.46	>0.1

Group A = Upper socio-economic status ; Group B = Lower socio-economic status.

TABLE X

Significance of difference of chest circumference (cm.) in two sexes by age.

Age (months)	GROUP A				Statistical significance		GROUP B				Statistical significance	
	BOYS		GIRLS		't' value	P value	BOYS		GIRLS		't' value	P value
	No.	Mean±SD	No.	Mean±SD			No.	Mean±SD	No.	Mean±SD		
24 - 30	40	46.11±1.32	35	44.13±0.93	7.57	<0.001	48	43.57±1.56	41	43.48±1.39	0.28	>0.10
30 - 36	42	48.30±1.66	47	47.17±1.91	2.98	<0.01	39	44.56±1.75	38	43.67±1.75	2.24	<0.05
36 - 42	45	49.08±1.67	40	48.63±2.10	1.08	>0.10	32	47.42±1.63	41	46.29±1.32	3.18	<0.001
42 - 48	42	50.12±2.34	43	49.05±2.46	2.05	<0.05	30	48.06±2.26	44	47.59±1.51	0.99	>0.10
48 - 54	48	50.70±2.56	45	48.80±1.86	4.11	<0.001	41	49.14±1.58	37	4.87±1.33	1.33	>0.10
54 - 60	48	51.56±2.62	55	50.72±2.32	1.71	>0.05	66	49.86±1.99	48	50.54±1.60	2.02	<0.05

Group A = Upper socio-economic status ; Group B = Lower socio-economic status.

that of lower for age-group 30-42 months only. In rest of the age-groups, however, the differences in head circumferences were not significant.

Table VII shows that boys of group A had higher head circumference than that of girls of the same group at all ages except at 30-42 months. In group B also, boys showed higher values of head circumference than girls for age-group 24-42 months. In rest of the age-groups such values did not differ significantly in two sexes.

Sex, Socio-economic Status and Chest Circumference

Chest circumference in two socio-economic groups and two sexes is shown in Tables IX and X. From Table IX, it is apparent that boys belonging to group A had higher values of chest circumference than those belonging to group B at all ages. Girls of group A too showed considerably higher values of chest circumference than those of group B in the age-group 24-42 months. It was important to note that girls of group B had shown higher such values than those of group A for age-group 42-48 months. At other age-groups, no significant differences in the values of chest circumference were seen.

Table X clearly shows that boys belonging to group A had greater values of chest circumferences than

MEAN HEAD CIRCUMFERENCE AND CHEST CIRCUMFERENCE

BOYS, GROUP-A INCOME > Rs 150/CAPITA/MONTH

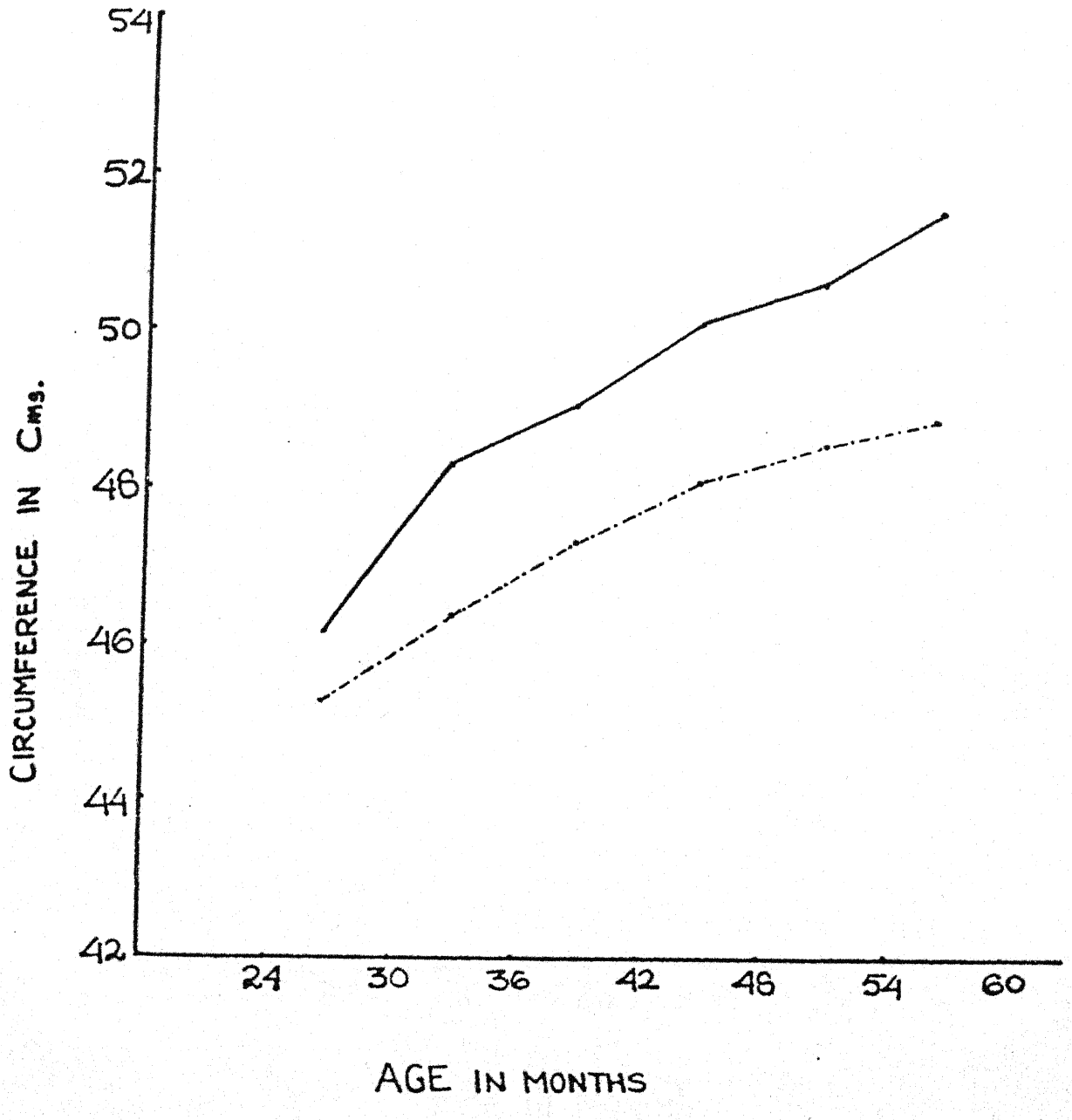

Fig. 5.

MEAN HEAD CIRCUMFERENCE AND CHEST CIRCUMFERENCE

GIRLS, GROUP-A INCOME > Rs 150/CAPITA/MONTH

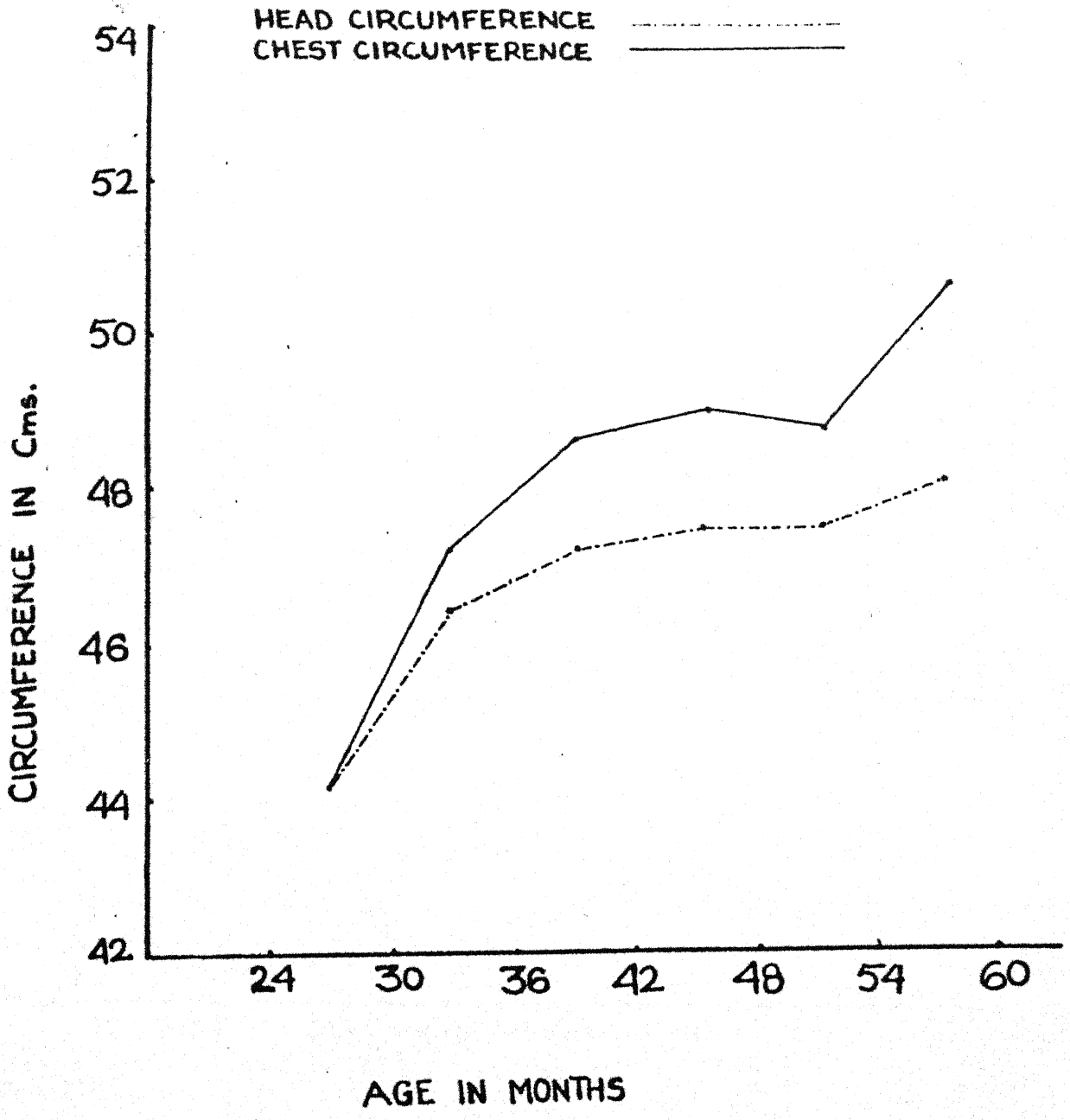

Fig. 6.

MEAN HEAD CIRCUMFERENCE AND CHEST CIRCUMFERENCE

BOYS GROUP-B INCOME < Rs 150/CAPITA/MONTH

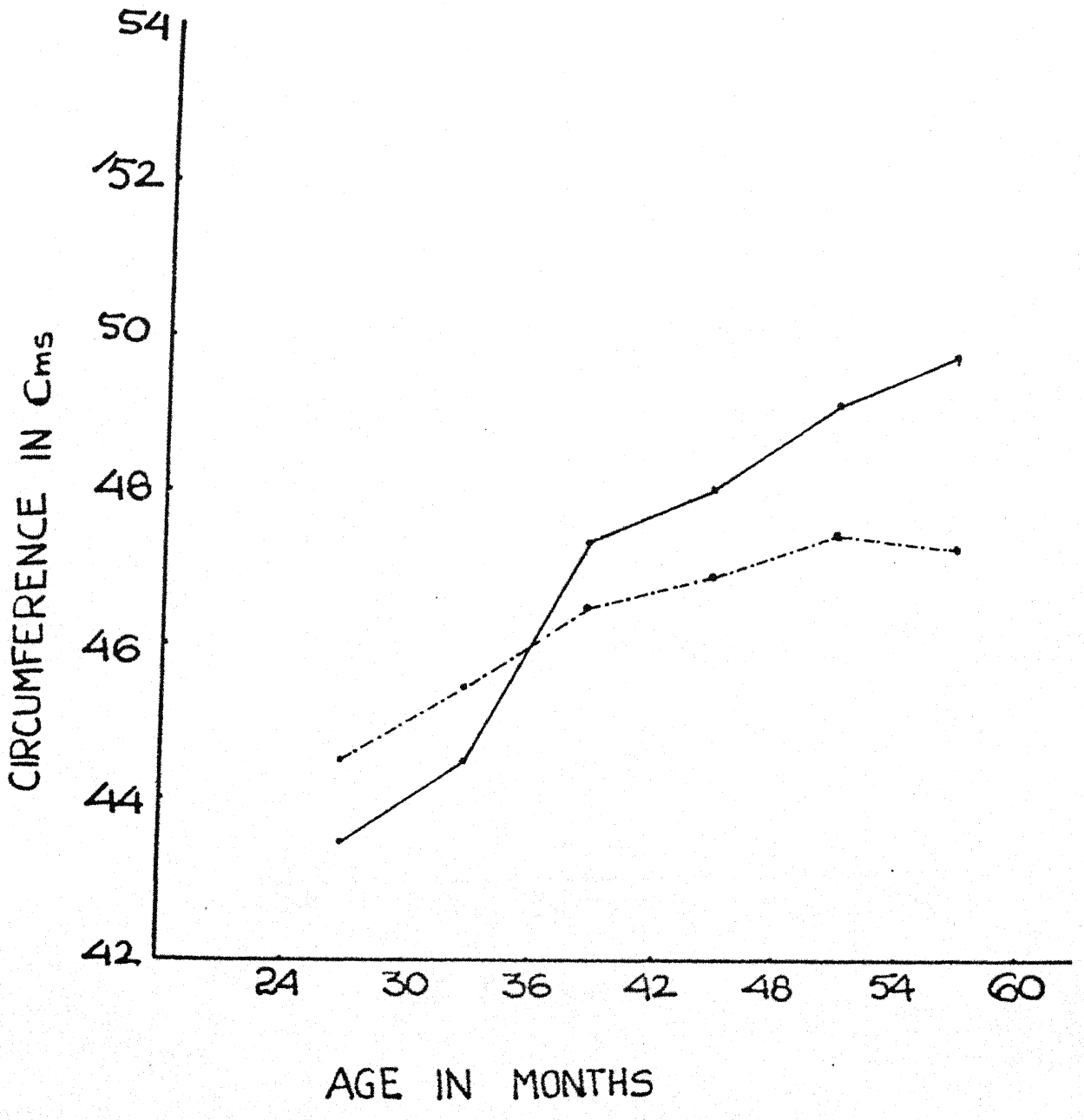

Fig. 7.

MEAN HEAD CIRCUMFERENCE AND CHEST CIRCUMFERENCE

GIRLS, GROUP-B INCOME < Rs 150/- PER CAPITA / MONTH

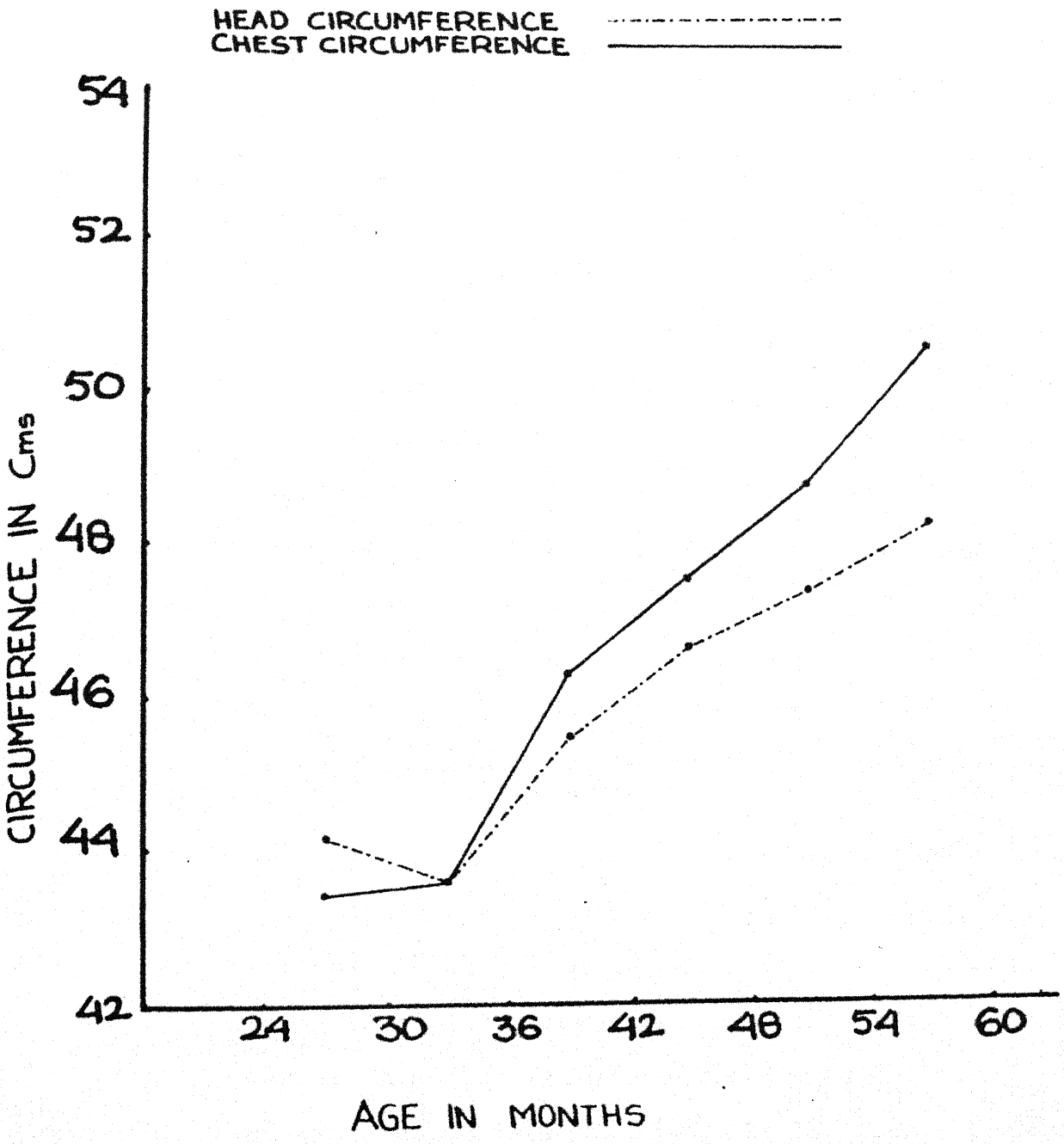

Fig. 8.

girls at all ages except 36-42 months and 54-60 months. In group B, boys had higher values of chest circumference than girls in age-group of 30-42 months only. However, for age-group 54-60 months, girls of group B showed higher such values than those of boys. At rest ages, differences were not statistically significant. Boys as well as girls (Fig. 5 to 8) showed a consistent increase in the head and chest circumferences with age. This was true, both for upper as well as lower socio-economic groups. Graphs (Fig. 5 to 8) further demonstrate the interesting findings in respect of crossing over of head and chest circumferences. It is seen that, for children belonging to upper socio-economic status, chest circumference overtook the head circumference before the age of 2 years in boys as against 24-30 months age in girls. However, for those who had come from poor socio-economic status, it occurred between the age of 30-36 months for both boys and girls.

Sex, Socio-economic Status and Mid-arm Circumference

Mid-arm circumference according to sex and socio-economic groups is shown in Tables XI and XII. Table XI clearly shows that in both the socio-economic groups, boys had significantly higher mid-arm circumferences than girls at all the ages. Such values increased with age for both boys and girls.

TABLE XI

Significance of difference of mid-arm circumference (cm.) in different socio-economic groups by age.

Age (months)	BOYS				Statistical significance		GIRLS				Statistical significance	
	GROUP A		GROUP B		't' value	P value	GROUP A		GROUP B		't' value	P value
	No.	Mean±SD	No.	Mean±SD			No.	Mean±SD	No.	Mean±SD		
24 - 30	40	13.33±0.65	48	12.11±0.86	7.57	<0.001	35	12.79±0.83	41	12.15±0.68	1.36	<0.001
30 - 36	42	14.53±1.00	39	12.52±0.71	10.48	<0.001	47	13.99±0.92	43	11.97±0.48	13.40	<0.001
36 - 42	45	14.52±0.97	32	13.17±0.69	6.61	<0.001	40	14.49±0.98	41	12.74±0.60	9.66	<0.001
42 - 48	42	14.21±0.92	30	13.06±0.77	7.75	<0.001	43	13.86±1.15	44	13.25±0.83	2.83	<0.01
48 - 54	48	14.75±0.89	41	13.41±0.71	9.48	<0.001	45	14.58±1.02	37	13.44±0.51	6.50	<0.001
54 - 60	48	14.75±0.85	66	13.67±0.69	7.23	<0.001	55	14.54±0.56	48	14.15±0.85	2.18	<0.05

Group A = Upper socio-economic status ; Group B = Lower socio-economic status.

TABLE XII

Significance of difference of mid-arm circumference (cm.) in two sexes by age.

Age (months)	GROUP A				Statistical significance		GROUP B				Statistical significance	
	BOYS		GIRLS		't' value	P value	BOYS		GIRLS		't' value	P value
	No.	Mean±SD	No.	Mean±SD			No.	Mean±SD	No.	Mean±SD		
24 - 30	40	13.35±0.65	35	12.89±0.83	5.52	<0.001	48	12.11±0.86	41	12.15±0.68	0.24	>0.10
30 - 36	42	14.53±1.00	47	13.99±0.92	2.64	<0.01	39	12.52±0.71	43	11.97±0.45	4.14	<0.001
36 - 42	45	14.52±0.97	40	14.49±0.98	0.14	>0.10	32	13.17±0.69	41	12.74±0.60	2.79	<0.01
42 - 48	42	14.21±0.92	43	13.86±1.15	1.55	>0.10	30	13.06±0.77	44	13.25±0.83	1.01	>0.10
48 - 54	48	14.75±0.89	45	14.58±1.02	0.85	>0.10	41	13.41±0.71	37	13.44±0.51	0.21	>0.10
54 - 60	48	14.75±0.85	55	14.54±0.96	1.77	>0.05	66	13.67±0.69	48	14.15±0.85	3.21	<0.01

Group A = Upper socio-economic status ; Group B = Lower socio-economic status.

From Table XII, it is evident that in group A, mid-arm circumference at age-group 24-36 months was greater in boys than girls. In all the other age-groups differences were statistically insignificant. In group B, only for age-group 30-42 months, boys had higher values than girls. At rest of the ages, differences, if any, were insignificant except for 54-60 months, where girls scored significantly higher values for mid-arm circumference than boys. Mid-arm circumference also increased significantly with age for boys as well as girls.

Sex, Socio-economic Status and Mid-thigh Circumference

Mid-thigh circumference in two socio-economic groups and in different sexes is shown in Tables XIII and XIV. Table XIII shows that mid-thigh circumference of boys was higher than girls at all ages and in both the socio-economic groups, except in the age-group 24-30 months. In this age-group, girls of group B scored higher values than their counterparts in group A.

From Table XIV, it is seen that boys from group A had higher values of mid-thigh circumference than girls from the same socio-economic group, at 24-36 and 48-54 months age. In rest of the age-groups, differences were not statistically significant. In group B, only at the age of 30-42 months, boys had higher

TABLE XIII

Significance of difference of mid-thigh circumference (cm.) in different socio-economic groups by age.

Age (months)	BOYS				Statistical significance		GIRLS				Statistical significance	
	GROUP A		GROUP B		't' value	P value	GROUP A		GROUP B		't' value	P value
	No.	Mean±SD	No.	Mean±SD			No.	Mean±SD	No.	Mean±SD		
24 - 30	40	24.08±2.10	48	20.31±2.17	8.26	<0.001	35	19.32±1.32	41	20.20±1.63	2.60	<0.05
30 - 36	42	24.70±1.36	39	21.08±1.38	11.88	<0.001	47	23.48±1.72	43	19.29±1.52	12.26	<0.001
36 - 42	45	25.88±1.77	32	23.38±1.62	6.42	<0.001	40	25.52±1.72	41	22.69±1.27	8.40	<0.001
42 - 48	42	25.88±1.94	30	23.06±1.08	7.86	<0.001	43	25.28±1.47	44	23.50±2.34	4.25	<0.001
48 - 54	48	27.38±1.93	41	23.87±1.34	10.07	<0.001	45	26.38±1.85	37	24.19±1.41	6.07	<0.001
54 - 60	48	26.78±1.62	66	24.47±1.49	7.77	<0.001	55	26.95±2.10	48	25.59±4.18	2.04	<0.001

Group A = Upper socio-economic status ; Group B = Lower socio-economic status.

TABLE XIV

Significance of difference of mid-thigh circumference (cm.) in two sexes by age.

Age (months)	GROUP A				Statistical significance		GROUP B				Statistical significance	
	BOYS		GIRLS		't' value	P value	BOYS		GIRLS		't' value	P value
	No.	Mean±SD	No.	Mean±SD			No.	Mean±SD	No.	Mean±SD		
24 - 30	40	24.08±2.10	35	19.32±1.32	11.89	<0.001	48	20.31±2.17	41	20.20±1.63	0.27	>0.10
30 - 36	42	24.70±1.36	37	23.48±1.72	3.46	<0.001	39	21.08±1.38	43	19.29±1.52	5.59	<0.001
36 - 42	45	25.88±1.77	40	25.52±1.72	0.95	>0.10	32	23.38±1.62	41	22.69±1.27	1.98	<0.05
42 - 48	42	25.80±1.94	43	25.28±1.47	1.60	>0.10	30	23.06±1.08	44	23.50±2.34	1.08	>0.10
48 - 54	48	27.38±1.93	45	26.38±1.85	2.55	<0.05	41	23.87±1.34	37	24.19±1.41	1.02	>0.10
54 - 60	48	26.78±1.62	55	26.95±2.10	0.46	>0.10	66	24.47±1.49	48	25.59±4.18	1.77	<0.05

Group A = Upper socio-economic status ; Group B = Lower socio-economic status.

TABLE XV

Significance of difference of calf circumference (cm.) in different socio-economic groups by age.

Age (months)	BOYS				Statistical significance		GIRLS				Statistical significance	
	GROUP A		GROUP B		't' value	P value	GROUP A		GROUP B		't' value	P value
	No.	Mean±SD	No.	Mean±SD			No.	Mean±SD	No.	Mean±SD		
24 - 30	40	18.08±1.15	48	15.48±0.89	11.67	<0.001	35	15.38±1.03	41	15.22±1.06	0.66	>0.10
30 - 36	42	18.34±1.08	39	15.81±1.07	10.58	<0.001	47	17.57±0.97	43	15.33±0.77	14.00	<0.001
36 - 42	45	18.50±1.31	32	17.14±1.34	4.43	<0.001	40	18.92±1.27	41	16.60±0.78	9.87	<0.001
42 - 48	42	18.9±1.53	30	17.13±0.86	6.24	<0.001	43	18.46±1.12	44	17.24±1.28	4.73	<0.001
48 - 54	48	19.60±1.30	41	17.24±2.60	5.27	<0.001	45	19.15±1.74	37	16.78±2.75	4.47	<0.001
54 - 60	48	19.46±1.10	66	17.91±0.97	7.80	<0.001	55	19.66±1.71	48	18.88±1.33	2.60	<0.05

Group A = Upper socio-economic status ; Group B = Lower socio-economic status.

TABLE XVI

Significance of difference of calf circumference (cm.) in two sexes by age.

Age (months)	GROUP A				Statistical significance		GROUP B				Statistical significance	
	BOYS		GIRLS		't' value	P value	BOYS		GIRLS		't' value	P value
	No.	Mean±SD	No.	Mean±SD			No.	Mean±SD	No.	Mean±SD		
24 - 30	40	18.08±1.15	35	15.38±1.03	10.72	<0.001	48	15.48±0.89	41	15.22±1.06	1.24	>0.10
30 - 36	42	18.34±1.08	47	17.57±1.97	3.52	<0.001	39	15.81±1.07	43	15.33±1.77	2.31	<0.05
36 - 42	45	18.50±1.31	40	18.92±1.27	1.49	>0.10	32	17.14±1.34	41	16.60±0.78	2.02	<0.05
42 - 48	42	18.90±1.53	43	18.46±1.12	1.51	>0.10	30	17.13±0.86	44	17.24±1.28	0.44	>0.10
48 - 54	48	19.60±1.30	45	19.15±1.74	1.40	>0.10	41	17.24±2.60	37	16.78±2.75	0.75	>0.10
54 - 60	48	19.40±1.10	55	19.66±1.71	0.92	>0.10	66	17.91±0.97	48	18.88±1.33	4.29	<0.001

Group A = Upper socio-economic status ; Group B = Lower socio-economic status.

values than the girls. For age-group 54-60 months, reverse was, however, true. In rest of the age-groups, almost similar values of mid-thigh circumferences were seen. Like other measurements, mid-thigh circumference also enhanced with age in either sex.

Sex, Socio-economic Status and Calf Circumference

Calf circumference in different socio-economic groups and for two sexes at various ages are shown in Tables XV and XVI. Table XV shows that mean calf circumference of boys from group A was more than those of group B at all ages. Such values for girls from group A were also more than their counterparts in group B at all ages, except at 24-30 months.

Analysis shown in Table XVI indicates that mean calf circumference of boys from group A was almost equal to that of girls from group A at all ages except 24-36 months, where boys had higher values than girls. In group B, boys had more calf circumference than the girls at 30-42 months of age. In rest of the age-groups differences were statistically insignificant except for age-group 54-60 months, where girls scored significantly higher values than boys. A consistent increase in the calf circumference values was observed for boys and girls (both socio-economic groups) with the increase in age.

TABLE XVII

Significance of difference of sub-scapular skinfold thickness (mm.) in different socio-economic groups by age.

Age (months)	BOYS				Statistical significance		GIRLS				Statistical significance	
	GROUP A		GROUP B		't' value	P value	GROUP A		GROUP B		't' value	P value
	No.	Mean±SD	No.	Mean±SD			No.	Mean±SD	No.	Mean±SD		
24 - 30	40	4.68±0.56	48	4.38±0.82	2.03	<0.05	35	4.82±0.79	41	4.58±0.69	1.39	>0.10
30 - 36	42	5.35±0.79	39	4.75±0.76	3.48	<0.001	47	6.17±0.92	43	4.79±0.71	8.00	<0.001
36 - 42	45	6.04±0.92	32	4.80±0.69	6.75	<0.001	40	6.57±1.12	41	5.02±0.73	7.35	<0.001
42 - 48	42	6.02±0.85	30	5.27±0.79	3.84	<0.001	43	6.27±0.91	44	5.76±1.06	2.41	<0.05
48 - 54	48	6.47±1.3	41	5.40±0.79	4.76	<0.001	45	5.83±1.09	37	5.39±0.84	2.06	<0.05
54 - 60	48	5.72±1.16	66	5.25±0.90	2.34	<0.05	55	6.26±1.20	48	5.93±1.38	1.28	>0.10

Group A = Upper socio-economic status ; Group B = Lower socio-economic status.

TABLE XVIII

Significance of difference of sub-scapular skinfold thickness (mm.) in two sexes by age.

Age (months)	GROUP A				Statistical significance		GROUP B				Statistical significance	
	BOYS		GIRLS		't' value	P value	BOYS		GIRLS		't' value	P value
	No.	Mean±SD	No.	Mean±SD			No.	Mean±SD	No.	Mean±SD		
24 - 30	40	4.68±0.56	35	4.82±0.79	0.87	>0.10	48	3.38±0.82	41	4.58±0.69	1.24	>0.1
30 - 36	42	5.35±0.79	47	6.17±0.92	4.52	<0.001	39	4.75±0.76	43	4.79±0.71	0.24	>0.1
36 - 42	45	6.04±0.92	40	6.57±1.12	2.36	<0.05	32	4.80±0.69	41	5.02±0.73	1.31	>0.1
42 - 48	42	6.02±0.85	43	6.27±0.91	1.30	>0.10	30	5.27±0.79	44	5.76±1.06	2.27	<0.01
48 - 54	48	6.47±1.30	45	5.83±1.09	2.57	<0.05	41	5.40±0.79	37	5.39±0.84	0.05	>0.1
54 - 60	48	5.72±1.16	55	6.26±1.20	2.31	<0.05	66	5.25±0.90	48	5.93±1.38	2.98	<0.01

Group A = Upper socio-economic status ; Group B = Lower socio-economic status.

MEAN SUBSCAPULAR SKINFOLD THICKNESS
ACCORDING TO SEX - GROUP-A

INCOME > Rs 150/CAPITA/MONTH

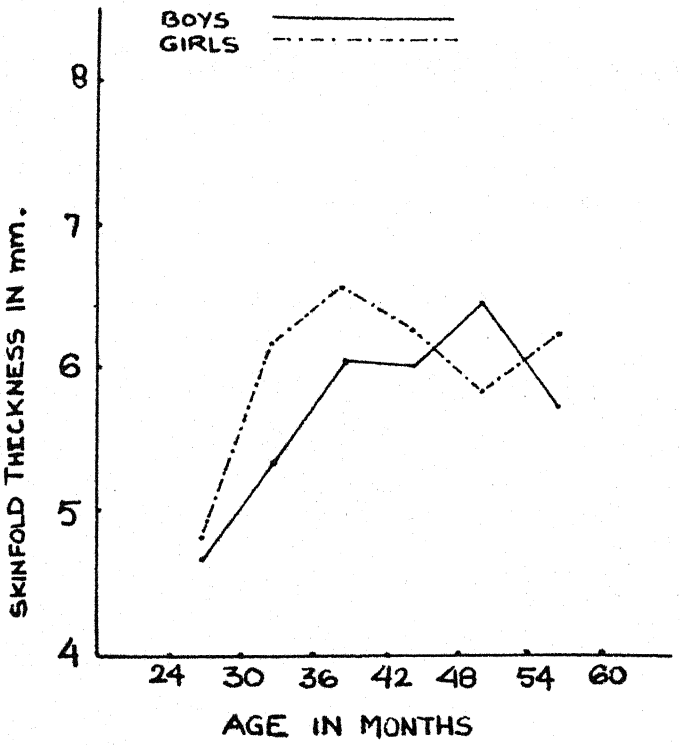

Fig. 9.

MEAN SUBSCAPULAR SKINFOLD THICKNESS
ACCORDING TO SEX - GROUP-B

INCOME < RS 150/CAPITA/MONTH

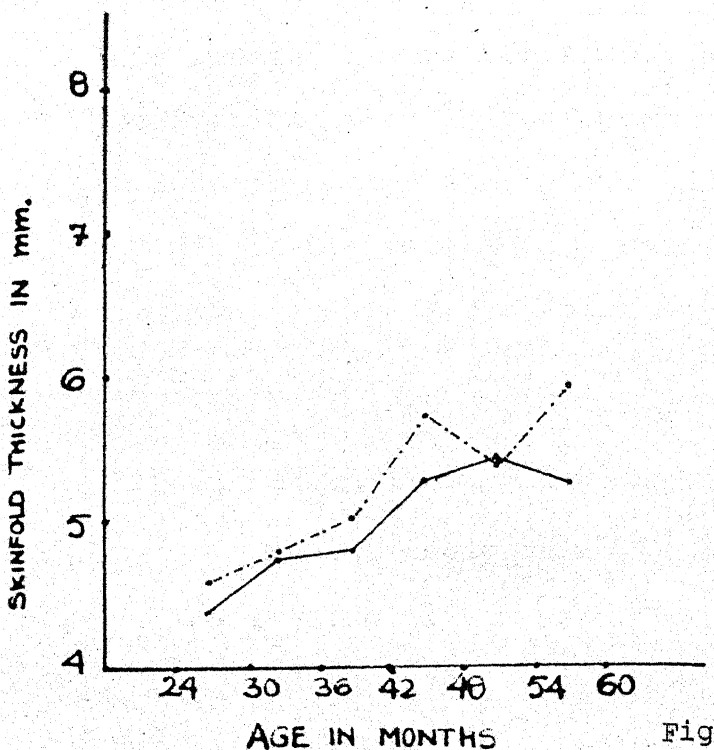

Fig. 10.

Sex, Socio-economic Status and Sub-scapular Skinfold Thickness

Sub-scapular skinfold thickness in relation to socio-economic status and sex has been shown in Tables XVII and XVIII. Table XVII shows that boys from upper socio-economic group had consistently greater values of sub-scapular skinfold thickness than those from lower socio-economic group at all ages. In case of girls, however, higher values were observed for upper socio-economic group at all ages, except at 24-30 months and 54-60 months of age.

From Table XVIII it is evident that the girls from group A had considerably greater values of sub-scapular skinfold thicknesses than that of boys of same socio-economic group at all ages except at 24-30 months and 42-48 months of age. In group B, such differences in the two sexes were statistically insignificant at all age-groups except at 42-48 months and 54-60 months age, where girls had significantly higher values than boys. Such values also showed an upward trend with the increase in age but more so in the lower age-groups (Fig. 9 and 10).

Sex, Socio-economic Status and Triceps Skinfold Thickness

Mean triceps skinfold thicknesses in relation to socio-economic status and sex are shown in Tables XIX

TABLE XIX

Significance of difference of triceps skinfold thickness (mm.) in different socio-economic groups by age.

Age (months)	BOYS				Statistical significance		GIRLS				Statistical significance	
	GROUP A		GROUP B		't' value	P value	GROUP A		GROUP B		't' value	P value
	No.	Mean±SD	No.	Mean±SD			No.	Mean±SD	No.	Mean±SD		
24 - 30	40	5.74±0.53	48	5.58±0.86	1.06	>0.10	35	6.00±0.83	41	4.58±0.69	8.02	<0.001
30 - 36	42	6.66±0.85	39	5.83±0.78	4.58	<0.001	47	7.47±1.01	43	5.94±0.76	8.16	<0.001
36 - 42	45	7.52±1.07	32	6.04±0.72	7.25	<0.001	40	8.29±1.28	41	6.26±0.83	8.44	<0.001
42 - 48	42	7.53±0.91	30	6.45±0.79	5.36	<0.001	43	7.88±1.11	44	6.96±0.99	3.94	<0.001
48 - 54	48	8.03±1-50	41	6.36±0.71	6.80	<0.001	45	7.64±1.37	37	6.86±1.31	2.62	<0.05
54 - 60	48	7.17±1.21	66	6.08±0.87	4.34	<0.001	55	7.81±1.32	48	7.45±1.55	1.25	>0.10

Group A = Upper socio-economic status ; Group B = Lower socio-economic status.

TABLE XX.

Significance of difference of triceps skinfold thickness (mm.) in two sexes by age.

Age (months)	GROUP A				Statistical Significance		GROUP B				Statistical significance	
	BOYS		GIRLS		't' value	P value	BOYS		GIRLS		't' value	P value
	No.	Mean±SD	No.	Mean±SD			No.	Mean±SD	No.	Mean±SD		
24 - 30	40	5.74±0.53	35	6.00±0.83	1.59	>0.10	48	5.58±0.86	41	4.58±0.69	6.08	<0.001
30 - 36	42	6.66±0.85	47	7.47±1.01	4.10	<0.001	39	5.83±0.78	43	5.94±0.76	0.64	>0.10
36 - 42	45	7.52±1.07	40	8.29±1.28	2.98	<0.01	32	6.04±0.72	41	6.26±0.83	1.21	>0.10
42 - 48	42	7.53±0.91	43	7.88±1.11	1.59	>0.10	30	6.45±0.79	44	6.99±0.99	2.60	<0.05
48 - 54	48	8.03±1.50	45	7.64±1.37	1.31	>0.10	41	6.36±0.71	37	6.86±1.31	2.06	<0.05
54 - 60	48	7.17±1.21	55	7.81±1.32	2.56	<0.05	66	6.28±0.87	48	7.45±1.55	4.71	<0.001

Group A = Upper socio-economic status ; Group B = Lower socio-economic status.

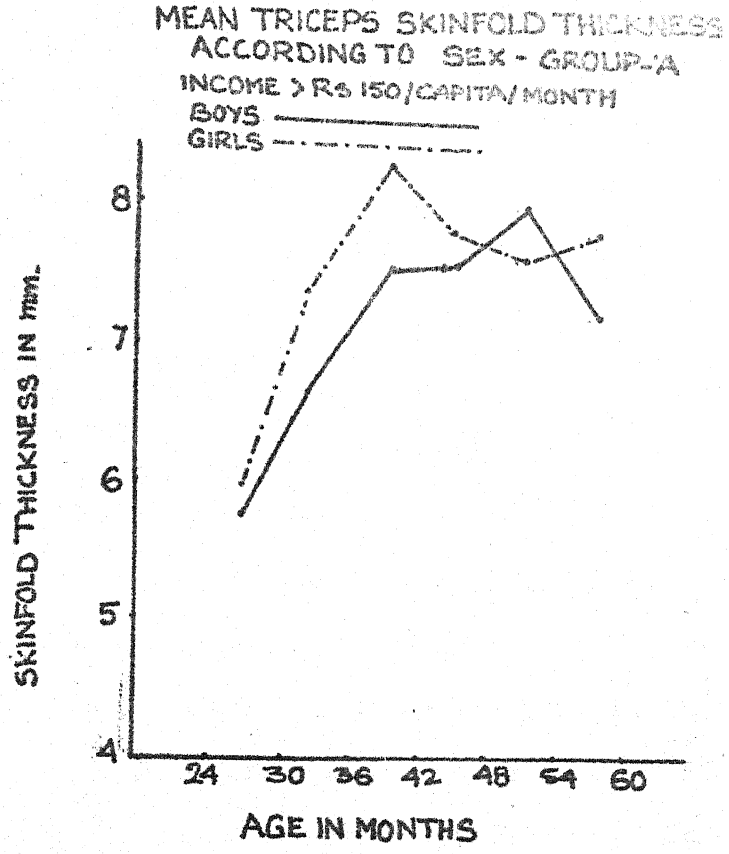
MEAN TRICEPS SKINFOLD THICKNESS
ACCORDING TO SEX - GROUP-A
INCOME > Rs 150/CAPITA/MONTH
BOYS
GIRLS
SKINFOLD THICKNESS IN mm.
8
7
6
5
4
24
30
36
42
48
54
60
AGE IN MONTHS

Fig. 11.

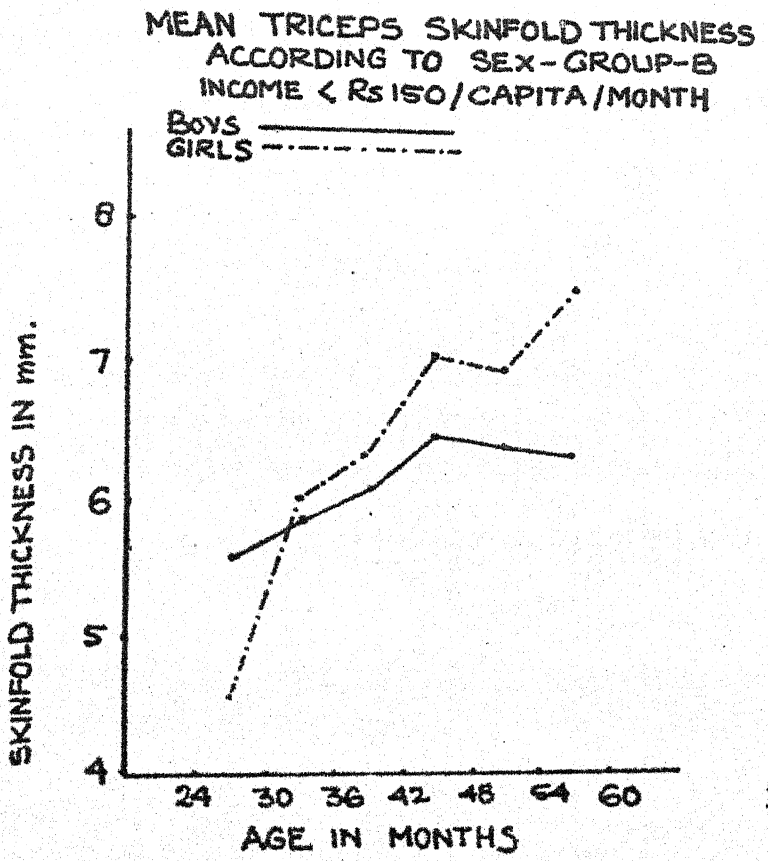
MEAN TRICEPS SKINFOLD THICKNESS
ACCORDING TO SEX - GROUP-B
INCOME < Rs 150/CAPITA/MONTH
BOYS
GIRLS
SKINFOLD THICKNESS IN mm.
8
7
6
5
4
24
30
36
42
48
54
60
AGE IN MONTHS

Fig. 12.

and XX. From Table XIX, it is apparent that boys from group A had thicker triceps skinfold than boys from group B at all ages except in the age-group of 24-30 months. Girls also showed a similar trend at all ages except at 54-60 months of age.

It is seen from Table XX, that there were significant differences in the mean thicknesses of triceps skinfold in group A in the two sexes, for all ages except at the age of 24-30 and 42-54 months. Girls showed significantly thicker triceps skinfold than boys. In group B, girls had higher values of triceps skinfold than boys at 42-60 months age. In the age-group of 24-30 months, boys had significantly higher values than that of girls of group B. At rest of the ages such differences were not statistically significant.

Fig. 11 and 12 show that there was no definite increase in triceps skinfold thickness with the increase in age atleast in the latter age-groups.

IMMUNIZATION STATUS.

Observations on the immunization status of children, in the present study are shown in Tables XXI, XXII and XXIII. These observations have been related to socio-economic and literacy status of parents.

Table XXI shows the distribution of children immunized by sex. Out of 1,040 children studied, 7.7%

TABLE XXI

Distribution of children immunized according to sex.

Immunization	BOYS		GIRLS		TOTAL	
	No.	%	No.	%	No.	%
Not done	15	2.86	65	12.52	80	7.69
Smallpox	506	97.12	443	83.36	949	91.25
B.C.G.	231	44.34	185	35.64	416	40.00
D.P.T.	195	37.42	138	26.60	333	32.02
Polio	226	43.38	177	34.10	403	38.75
All the four	94	18.04	90	9.83	184	17.69
Total	521	50.1	519	49.9	1040	

TABLE XXII

Distribution of children immunized according to socio-economic status.

Immunization	GROUP A		GROUP B		TOTAL	
	No.	%	No.	%	No.	%
Not done	20	3.77	60	11.76	80	7.69
Smallpox	501	94.53	448	87.84	949	91.25
B.C.G.	274	51.69	142	27.84	416	40.00
D.P.T.	229	43.21	104	20.39	333	32.02
Polio	281	53.02	122	23.92	403	38.75
All the four	150	28.30	34	6.67	184	17.69

were totally unimmunized. Out of all, 91.3% children were vaccinated for smallpox, 40.0% for B.C.G., 32.0% for D.P.T. and 38.8% for Polio. Only 17.7% of children were vaccinated with all the vaccines mentioned above. Overall percentages of boys immunized with smallpox, B.C.G., D.P.T. and Polio vaccines were 97.1%, 44.3%, 37.4% and 43.4% respectively. A total of 18.09% boys were vaccinated with all the 4 vaccines. Similarly, overall percentages for girls, immunized against smallpox, B.C.G., D.P.T. and Polio were 83.4%, 35.6%, 26.6% and 34.1% respectively. Only 9.8% of girls were immunized with all the 4 vaccines. It was observed that 2.9% of boys and 12.5% of girls were not immunized at all.

The distribution of immunized children, according to socio-economic status is shown in Table XXII. There were 3.8% children belonging to upper socio-economic group and 11.8% from lower socio-economic group who had not been immunized with any of the vaccines. In group A, percentage rates of vaccination for smallpox, B.C.G., D.P.T. and Polio vaccines were 94.5%, 51.7%, 43.2% and 53.3% respectively. In group B, such rates of vaccination were 87.8%, 20.4% and 23.9% respectively. A total of 28.3% of the children from upper socio-economic group were immunized with all the 4 vaccines. In general, percentage rate of the

TABLE XXIII

Distribution of children immunized according to the literacy status of parents.

Immunization	Illiterate		Primary		Jr. High School to Intermediate		Graduate & Postgraduate		Professional		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Not done	30	14.42	30	11.20	10	4.42	8	3.70	2	1.64	80	7.69
Smallpox	169	81.25	238	88.80	214	94.69	208	96.30	120	98.36	949	91.25
B.C.G.	5	2.40	24	8.96	131	57.96	154	71.30	102	83.60	416	40.00
D.P.T.	18	8.65	60	22.38	60	26.54	96	44.4	99	81.15	333	32.01
Polio	39	18.75	80	29.85	80	35.4	98	45.36	106	88.52	403	38.75
All the four	3	1.44	20	7.46	14	18.14	52	24.07	68	55.73	184	17.70
Total	208	20.00	268	25.77	226	21.73	216	20.77	122	11.73	1040	100.00

vaccination was more in the children from upper socio-economic group than those from lower socio-economic group.

Table XXIII shows the distribution of immunized children by literacy status of parents. It is clear from the tables that children of illiterate parents had lower percentage rate of vaccination as compared to those whose parents had higher education. Percentage rates of vaccination in children, whose parents were illiterate, were 81.3%, 2.4%, 8.7% and 18.8% for smallpox, B.C.G., D.P.T. and Polio respectively. As many as 14.4% children in this group were not immunized for any one of the vaccines and only 1.4% were vaccinated for all of them. It may be seen from Table XXIII that, the percentage rate of vaccination increased with the increasing literacy status. In children whose parents had professional education, percentage rates of vaccination for smallpox, B.C.G., D.P.T. and Polio were 98.4%, 83.6%, 81.2% and 88.5% respectively. Almost 56% children were vaccinated with all of the above mentioned vaccines and only about 2% had received no vaccination at all.

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D I S C U S S I O N

DISCUSSION

A cross sectional growth study on 1,040 pre-school children (2-5 years) of Jhansi and its surrounding areas was conducted between March 1980 to January 1981. Nine anthropometric measurements viz. weight, height, head circumference, chest circumference, mid-arm circumference, mid-thigh circumference, calf circumference, sub-scapular and triceps skinfold thickness were taken in each child. Immunization status in each child was noted at the time of contact. Cases were stratified on the variables of sex and socio-economic status. Statistical analysis was done to derive means and standard deviations. Further, 't' test was applied to see the significance of difference between the pairs of uncorrelated means at each age group. Observations have been presented in Tables I to XXIII. Both, sex and socio-economic ratios in 1,040 children studied, were approximately 1 : 1.

For weight and height measurements, pooled means were calculated for the sake of comparison with I.C.M.R. and Harvard standards.

WEIGHT

Measurement of weight is still one of the most simple, commonly used and reliable method for the

TABLE XXIV

Comparison of pooled means (weight and height) of present series and I.C.M.R. Standard by age.

Age (years)	WEIGHT (Kg.)				HEIGHT (Cm.)			
	BOYS		GIRLS		BOYS		GIRLS	
	Present series	I.C.M.R. Standard	Present Series	I.C.M.R. Standard	Present Series	I.C.M.R. Standard	Present series	I.C.M.R. Standard
2 +	10.12	10.10	9.49	9.60	82.13	81.60	75.49	80.10
3 +	12.60	11.80	12.24	11.20	88.66	88.80	85.29	87.20
4 +	13.72	13.50	13.67	12.90	96.00	99.81	95.31	94.50

assessment of growth in children.

Relation to Sex and Socio-economic Status :

Fig. 1 and 2 indicates that weight in both boys as well as girls, showed an increasing trend with age. Same trend was also observed by many other workers (Falkner, 1958; Stuart and Stevenson, 1959; Rao et al, 1969). In this study, comparison of the mean weight in comparable socio-economic groups did not reveal any significant difference owing to the sex of the child. This was true for all the age-groups, except that boys in the upper socio-economic status were heavier at two extreme age-groups and girls were heavier at 30-42 months of age. These findings are in agreement to those observed by Prasad et al (1971) and Sastry et al (1973). However, Falkner (1958), Tanner et al (1966), Rao et al (1969) and Chaudhuri et al (1972) are of the view that there existed a significant difference in two sexes. They observed that boys were always heavier than girls at all ages.

From table III it is obvious that mean weight of boys as well as that of girls was significantly higher in those from group A than those from group B, at all ages. Similar relation of socio-economic status with weight was observed by Udani (1963), Currimbhoy (1963), Datta Banik et al (1970) and Prasad et al (1971). When values of

pooled mean weight (two socio-economic groups and certain age-groups were pooled) were compared to I.C.M.R. standards (Table XXIV) it was observed that mean values in the present study were comparable to these standards. Pooled mean weight values in the present study were between 100.2% - 106.8% for boys and 98.8% - 109.3% for girls when compared to I.C.M.R. standards. On the other hand when pooled mean weight values of children from upper socio-economic group in the present series were compared to median values (50th percentile) of Harvard standard, they were between 82.3% - 85.3% for boys and 78.3% - 84.5% for girls at different ages. However, this comparison would not be very accurate since the Harvard values represented the medians. Also, the age points were specific in Harvard study and not grouped as in the present series. Although Udani (1963) and Currimbhoy (1963) have observed that Indian children from upper socio-economic classes were having comparable weight values, to western standards, the same conclusion could not be drawn from our study.

HEIGHT

Height is usually not affected in acute malnutrition and stunting occurs mainly in chronic malnutrition.

Relation to Sex and Socio-economic Status :

An increasing trend in height with age was observed in the present study (Fig. 3 and 4). It can be

seen (Tables V and VI) that in general there was no significant difference in height in the two sexes of comparable socio-economic group. Tanner (1952) also had not observed significant difference between two sexes. He further stated that difference in height in two sexes became apparent at the time of puberty. However, Falkner (1958) observed that boys were significantly and consistently taller than girls at all ages. Among Indian workers, Ghai et al (1970), Chaudhuri et al (1972) and Bhargawa et al (1980) had shown that boys were taller than girls at all ages. In contrast Rao et al (1969), Shrivastava et al (1970), Prasad et al (1971) and Sastry et al (1973) observed no significant difference in height, between two sexes.

Comparing the socio-economic groups, both boys as well as girls from upper socio-economic group have shown consistently higher values for height, as compared to those from lower socio-economic group (Table V). Similar findings were observed by Udani (1963), Datta Banik et al (1970), Prasad et al (1971) and Dhamija et al (1976).

When pooled mean weight values of present study (Table XXIV) were compared to I.C.M.R. standards, it was observed that pooled mean height values were in between 99.8% - 100.6% for boys and between 94.2% - 100.9% for girls. However values observed in present study were much

less than those of Harvard standards. On the other hand when pooled mean heights of children from upper socio-economic group were compared to median values of Harvard standard (50th percentile), it was observed that mean values of height in present series were in between 92.4% - 93.5% for boys and 86.9% - 91.0% for girls, at different ages.

HEAD CIRCUMFERENCE.

In the present study from the Tables VI and VII, and from Figs. 5 - 8, it is obvious that head circumference increased with age, both in boys as well as in girls, in either socio-economic groups.

Relation to Sex and Socio-economic Status :

It was seen that mean head circumference of boys was significantly higher than girls at all ages except at 30-42 months in group A and at 42-54 months in group B, where the differences between two sexes were not significant. Udani (1963), Shrivastava et al (1970), Prasad et al (1971), Mathur et al (1972) and Dhamija et al (1976) observed that during pre-school age, a significant difference existed for the values of head circumference between two sexes and boys scored higher values than girls in their study. The sex differences were not consistently significant in our study.

When children from two socio-economic groups were compared, it was seen that boys from group A had

greater head circumference than those from group B at all ages. However, difference was not much marked between two socio-economic groups in case of girls. Many observers have shown that head circumference was significantly more in children from upper socio-economic classes as compared to those from lower (Stoch et al, 1963; Rao et al, 1969; Desai, 1971 and Chaudhuri et al, 1972).

In contrast some workers have also observed that there was no significant difference in head circumference in children from upper and lower socio-economic classes. Illingworth et al (1949) quoting Wallace remarked that in case of malnutrition some tissues were effected more than others, growth of the brain being affected least of all as compared to bone and muscle tissues. Udani (1963) and Prasad et al (1971) found that head circumference was not affected to any significant level as a result of socio-economic status.

CHEST CIRCUMFERENCE.

Figs. 5-8 show that mean values of chest circumference had a positive relationship with age. Statistical analysis of chest circumference measurements is shown in Tables IX and X.

Relation to Sex and Socio-economic Status :

In present series mean chest circumference was observed to be more in boys than girls but differences

were not uniformly significant. Rao et al (1969), Ghai et al (1970), Prasad et al (1971), and Naik et al (1975) have observed that chest circumference was consistently higher in boys than in girls.

Statistical analysis of values of chest circumference showed that its values were consistently more in children from upper socio-economic groups than those from lower socio-economic group, at all ages except that in group B at 48-60 months, differences between two groups were not significant. These observations in present study are very well in agreement to those observed by Udani (1963), Currimbhoy (1963), Prasad et al (1971) and Bhargawa et al (1980).

Relation between Head and Chest Circumference :

Figs. 5-8 show the relation between head and chest circumferences in different socio-economic groups and two sexes separately.

In present series chest circumference overtook the head circumference before two years of age in boys and between 24-30 months in girls, from the upper socio-economic class. However, Jelliffe (1966) concluded that in well nourished children chest circumference overtook the head circumference, shortly after 6 months of age. Udani (1963), Ghai et al (1968), Prasad et al (1971) and Shinde et al (1980) from various parts of our country, have observed that overtaking took place at about one year of age, in children from upper socio-economic class.

In children from lower socio-economic group, chest circumference became larger than head circumference at 30-36 months age, in this series. These observations are similar to those of Rao et al (1969), Prasad et al (1971), Chaudhuri et al (1972), Mathur et al (1972), Dhamija et al (1976) and Naik et al (1980).

MID-ARM CIRCUMFERENCE

Mid-arm circumference is one of the best measurements in reflecting the malnutrition in field surveys, but very little difference exists between two sexes and at different ages during pre-school period (Jelliffe, 1966).

Relation to Sex and Socio-economic Status :

As it is obvious from Tables XI and XII that differences in mid-arm circumference were not marked between two sexes. Only at the age intervals 24-36 months in group A and at 30-42 months in group B, boys showed significantly higher values than girls. As in the present study, not much sex difference was observed by Rao et al (1969), Srivastava et al (1970), Chaudhuri et al (1972) and Sastry et al (1973).

When mid-arm circumference in two socio-economic groups was compared, significantly higher values were scored by children belonging to upper socio-economic class than those from lower socio-economic class at all ages. Similar observations were made by Datta Banik et al (1970),

Naik et al (1976), Visweswara Rao et al (1978) and Man Mohan et al (1980).

Jelliffe and Jelliffe (1969) and Rutishauser (1969) have observed that mid-arm circumference was significantly affected with malnutrition in pre-school children.

Values of mid-arm circumference, in present study were nearly comparable to those of I.C.M.R. standards, but were significantly lower at all ages when compared to Wolanski standards (1964).

MID-THIGH CIRCUMFERENCE.

Tables XIII and XIV show the mean values of mid-thigh circumference observed in this study.

Relation to Sex and Socio-economic Status :

It was observed that there was no consistent difference in the mean values of mid-thigh circumference between two sexes at different ages.

However, when two socio-economic groups were compared, there were consistent and highly significant differences in the mean mid-thigh circumference. Children (boys as well as girls) from upper socio-economic group scored higher values than those from lower socio-economic group at all ages. No published reports were available on pre-school children (from India and abroad), to compare our observation with other workers.

CALF CIRCUMFERENCE

From Tables XV and XVI it is obvious that there is a positive relationship between mean calf circumference and age.

Relation to Sex and Socio-economic Status :

Calf circumference did not show much difference in two sexes at different ages, extending from 2-5 years age. Mean values showed a bizarre pattern at different ages. Malcolm (1956), Rao et al (1969) and Ghai et al (1970) have also observed that there was not much difference in calf circumference values between two sex.

Comparison of two socio-economic status showed that mean calf circumferences were significantly and uniformly more in children from upper socio-economic group than those from lower socio-economic group, at all age intervals. These observations are in agreement with those made by Malcolm (1956), Gopalan (1968), Datta Banik et al (1970) and Visweswara Rao et al (1978). Further, these authors have also commented that calf circumference is significantly affected in malnutrition, typically during weaning period. Mean values of calf circumference observed in this study are comparable to those observed by Rao et al (1969), Ghai et al (1970) and Visweswara Rao et al (1978).

SKINFOLD THICKNESS

Sub-scapular and triceps skinfold thickness were measured in the present study and their values have been shown in Tables XVII - XX.

TABLE XXV.

Comparison of skinfold thickness, present series with Shinde et al (1980), upper socio-economic group.

Sub-scapular skinfold thickness (Log unit)						Triceps skinfold thickness (Log unit)					
	Present series		Shinde et al				Present series		Shinde et al		
Age (years)	Boys	Girls	Age (years)	Boys	Girls	Age (years)	Boys	Girls	Age (years)	Boys	Girls
2 +	151	158	2	160	161	2 +	164	170	2	190	193
3 +	162	166	3	156	161	3 +	176	180	3	186	190
4 +	163	163	4	151	154	4 +	176	177	4	175	181

Sub-scapular Skinfold Thickness in Relation to Sex and Socio-economic Status :

It was seen in the present study that, though, girls had generally thicker sub-scapular skinfold than boys at all ages but the difference between two sexes were not statistically significant in most of the age-groups.

However, sub-scapular skinfold thickness was significantly more in children from upper socio-economic group than those from lower socio-economic group, at all the age intervals.

Mean values for sub-scapular skinfold thickness of children from upper socio-economic group of present study were converted to log units and were compared to those observed by Shinde et al (1980). It is seen from Table XXV that during 3-5 years children, both boys and girls of present study had higher values of skinfold thickness than their counterparts in Shinde's series. This may not be exactly true because measurements in Shinde's series were taken at yearly intervals (± 15 days) whereas in present series children were grouped at 6 monthly interval and pooled values were calculated for comparison

Triceps Skinfold Thickness in Relation to Sex and Socio-economic Status :

In the present study mean triceps skinfold thickness in boys was generally less than girls almost

at all ages; but statistically significant differences were observed only at 30-42 months and 54-60 months in group A and at 42-60 months in socio-economic group B children.

Tanner and Whitehouse (1962), Rao et al (1969), Chaudhuri et al (1972), Sastry et al (1973), have also observed that girls in general had thicker triceps skinfold than boys at all ages but differences were not statistically significant.

When the values of triceps skinfold thickness were compared in two socio-economic groups, it was observed that children belonging to socio-economic group A had thicker triceps skinfold than those belonging to group B. Differences were statistically highly significant in both, boys as well as girls, at all ages except at 24-30 months in boys and at 54-60 months in girls.

When triceps skinfold thickness of children of upper socio-economic group of present series were compared to those of Shinde's series, these values were higher in both the sexes in the latter series.

Comparison of triceps skinfold thickness values of present series, with those of Chaudhuri et al (1972) showed that values of latter series were more than those observed in boys of lower socio-economic group of present series, but were less than values for upper socio-economic groups of present series in both the sexes. Girls of group B of present series had comparable skinfold thickness to those observed by Chaudhuri et al(1972).

Thus it is obvious from the above discussion that sex differences for all the anthropometric measurements were not uniformly significant in all the age-groups. However, such differences due to varying socio-economic status were mostly significant. The possible explanations for these findings could be as follows.

(i) Sampling Error : There could have been an error in sampling, but as it is obvious from the tables that differences in various anthropometric measurements were mostly in different age-groups and in different socio-economic strata. If there had been an error in sampling, discrepancies should have occurred in the same age-group for more than two or three measurements. But after going through the observations and calculations in detail, no relationship was found between discrepancies and age-groups, sex or socio-economic status. So this could not be a likely explanation.

(ii) Faulty Measurement Technique - This may also be a likely explanation for discrepancies observed. But since all the measurements were taken by only one observer, this explanation does not hold good.

(iii) Chance occurrance - Thirdly it is also possible that these discrepancies were merely a chance occurrence.

Further studies are required, to find out an explanation for these discrepancies. Because in present

study we could only eliminate the sex and socio-economic factors. However, advanced statistical analysis might throw some light over the cause of these discrepancies by eliminating their co-variables such as genetic inheritance, dietary habits, educational status, availability of health services etc. These factors are, by and large, known to affect the growth of children.

IMMUNIZATION STATUS.

Beside anthropometric measurements, immunization status is also an important parameter which can affect the health status, particularly during the early years of life. During the pre-school age period, children are very much susceptible to various infectious diseases, especially in a developing country, like ours. If not all, many infectious diseases such as smallpox, tuberculosis, measles, polio, diphtheria, tetanus, whooping cough and many others, can be successfully prevented by vaccination.

In India, though immunization status is not satisfactory, but mass vaccination through our national programme has erradicated a dreaded disease which was quite rampant a few years back. To maintain this state, a continuous surveillance is essential for years to come.

Immunization status observed in this area is presented in Tables XXI - XXIII according to sex, socio-economic status and educational status in that order.

Table XXI shows distribution of children according to sex. It is obvious that in boys percentage of vaccination was more than girls for almost all the vaccines, i.e. smallpox, B.C.G., D.P.T. and Polio. Similar findings were observed by Sharma et al (1977). In the present study, 91.25%, 40.00%, 32.02% and 38.75% of 1,040 children were vaccinated with smallpox, B.C.G., D.P.T. and Polio, respectively. Only 17.69% children were vaccinated for all the vaccines mentioned above and 7.69% had not received any of the vaccines. The rate of vaccination in the present series was observed to be higher than that observed by Gupta and Agrawal (1972), Gulati et al (1973), Bhandari et al (1975), Sharma et al (1977) and Kumar et al (1978). This is probably due to the fact that areas studied in this study are under the Social and Preventive Medicine Department of this college and vaccination services are provided in mass, time to time by them.

In general children belonging to upper socio-economic group showed higher rates of vaccination than those from lower socio-economic group. Gupta and Agrawal (1972), Philip et al (1976), Sharma et al (1977) and Kumar et al (1978) also observed higher percentage of vaccination in children from upper socio-economic classes than those from lower socio-economic classes. Only 3.77% children from upper socio-economic class and

11.76% of children from lower socio-economic class had not received any vaccination at all. In group A 28.30% and in group B 6.67% of children had received all the four vaccines.

As far as literacy status is concerned, percentage rate of vaccinated children was more when family status for literacy was more, as compared to those whose family emmbers were illiterate. This was true for all the vaccines. Gulati et al (1973), Bhandari et al (1975), Philip et al (1976) and Hooja et al (1976) observed a similar relationship between percentage rate of vaccination and literacy status.

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SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

The present study on anthropometric measurements and immunization status of pre-school children, was conducted in the Department of Paediatrics, M.L.B. Medical College, Jhansi (U.P.). One thousand and fourty children between the ages of two to five years, belonging to different socio-economic status comprised the material for the present cross-sectional study. Cases were pooled from the well baby clinic of the Paediatrics department, M.L.B. Medical College, Jhansi, four villages in district Jhansi (Pichhore, Digara, Bhagwantpura and Karganwa), Parichha colony, Jhansi, and five Nursery schools situated in Jhansi city.

Out of 1,040 children, there were 521 (50.1%) boys and 519 (49.9%) girls. Almost equal number of children were drawn from urban and rural areas.

For the purpose of analysis children were divided into six age-groups and two socio-economic groups.

From the data collected, mean, standard deviation and 't' values were calculated for each measurements at different age-groups separately for boys and girls, in relation to their socio-economic groups.

Immunization status of children was studied in relation to sex, socio-economic status and educational standard of their parents.

Means of all nine anthropometric measurements at various age-groups have been compared and discussed.

WEIGHT

Positive relation with age was observed. In general boys were heavier than girls at all ages.

The pooled mean weights of boys at 2+, 3+ and 4+ age (in years) were 10.12, 12.60 and 13.72 kg. respectively. For girls of similar age-groups the values of pooled mean weight were 9.49, 12.24 and 13.67 kg. respectively.

Boys and girls from upper socio-economic groups were significantly heavier than their counterparts in lower socio-economic groups.

No significant difference in weight was observed in two sexes of some socio-economic group.

HEIGHT

In general boys were taller than girls at all ages. The pooled mean heights of boys at 2+, 3+ and 4+ ages (in years) were 82.13, 88.66 and 95.82 cm. respectively. These measurements for girls were 75.49, 85.27 and 95.31 cm. respectively at same ages.

Boys as well as girls from upper socio-economic groups were significantly taller than their counterparts in lower socio-economic group. However, no significant difference in height was observed in two sexes of same socio-economic group.

HEAD AND CHEST CIRCUMFERENCE.

An increasing trend with age was observed. Children from upper socio-economic group had significantly more values for head circumference.

No uniform difference in head circumference was observed between two sexes of same socio-economic group.

In upper socio-economic group chest circumference overtook the head circumference before 2 years age in boys and between 24-30 months in girls.

In lower socio-economic status this phenomenon took place at a latter age i.e. 30-36 months, in both boys and girls.

MID-ARM, MID-THIGH AND CALF CIRCUMFERENCE.

Mid-thigh and calf circumferences increased with age. All the three circumferences showed higher values in children from upper socio-economic group.

No consistant difference was observed in two sexes of the same socio-economic group.

Weight and height measurements were comparable to those of I.C.M.R. standard. Comparison of present series with western standard showed that children comprising the present study lagged far behind their counterparts in western countries. It could be due to racial environmental or economic factors acting alone or in combination.

SKINFOLD THICKNESS.

Skinfold thickness increased with age in initial months upto 36-42 months; thereafter it remained nearly same.

Both sub-scapular and triceps skinfold thickness were more in children from upper socio-economic group.

Though, statistically not significant, girls had higher values for both measurements than boys at all the age intervals.

IMMUNIZATION STATUS.

Percentage rates of preventive vaccinatios status were studied for smallpox, B.C.G., D.P.T. and Polio vaccines. 17.69% children received all the vaccines. However, only 7.69% children had no vaccination. Percentage of vaccination was more in boys than in girls.

More children of higher socio-economic group and educated parents were vaccinated than those of lower socio-economic status and of uneducated parents.

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Name

Sex Male/Female

Approximate date of birth

Age

Father's Name

Address

Occupation - Father

Mother

Total Income of the Family

Per Capita Income

Type of Family - Single/Joint

Size of Family

Educational Status

	Nil	Primary	High School	Inter	Gra-duate	P.G.	Others
Father							
Mother							

Birth order of the Chiid

Geneological Tree

Dietary History - Infancy— Breast Milk, Top Milk, Cow's, Buffalo, Goat, Tinned, other

—Dilution of Milk

—Age of Weaning

Present Diet-

Veg/Non Veg/Egg

Immunization History

Vaccination	Age of Vaccination	Vaccination	Age of Vaccination
Small Pox		BCG	
DPT I		Polio I	
II		II	
III		III	
Booster		Booster	
Any Other			

Relevant Antenatal and Natal History

—Drug taking

- Illness

Post natal History

No Problem	Jaundice	Cyanosis	Sepsis	Diarrhoea	Fever	

Mile Stones

	Age.
Social Smile	
Neck holding	
Sitting	
Crawling	
Standing	
Walking	

Family History

Past & Present Illness

	No Problem	Diarrhoea	Fever	Resp. Inf.	Worm Infest	Jaundice	
Past							
Present							

Clinical Examination

General Appearance :- Healthy/Weak/Ill looking/Malnourished

Nutrition — Normal/Malnutrition-Mild/Moderate/Severe

Pallor — - Nil, + ++ +++

Oedema — - Nil + ++ +++

Skin Changes — - Normal/Rough/Dry/Dehydrated

Vit Deficiency

A	B	C	D	

Hair Changes

Any Other

Systemic Examination

Cardiovascular System
- Normal
- Any Abnormality

Resp. System
- Narmal
- Any Abnormality

CNS
- Normal
- Any Abnormality

Abdomen
- Liver
- Spleen
- Pot Belly
- Any other

ANTHROPOMETRY

Measurment		Percentile
1. Weight	Kg.	
2. Height	Cms	
3. Head Circumference	Cms	
4. Chest Circumference	Cms	
5. Mid Arm Circumference	Cms	
6. Mid Thigh Circumference	Cms	
7. Mid Leg Circumference	Cms	
8. Subscapular Skin Thickness	m.m.	
9. Triceps Skinfold Thickness	m.m.	